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Allied close air support 1943-1945.

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ALLIED CLOSE AIR SUPPORT 1943-1945.

Ph.D Thesis.

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DESCRIPTION OF THESIS.

This thesis is a study of close air support within the historical context of World War II, with the analysis focusing upon the use of tactical air power by British and American forces during the campaigns in North-West Europe and Italy in 1943-45. The thesis addresses the fundamental questions of whether the employment of air resources in the close support role provided sufficient advantage at the battlefront to justify the associated expenditure of effort and the risk to aircraft and pilots, and whether air support proved to be of more value, and more cost effective, when directed upon interdiction targets beyond the immediate battlefront, such as German communications, transport, and supplies.

The principal sources consulted were contemporary Army and Air Force formation and unit records and reports, and contemporary Allied Operational Research (OR) material. The thesis examines the nature of Operational Research in the period, the joint Air Force/Army systems established by both the British and Americans for providing and controlling air support, the characteristics of fighter-bomber aircraft, and the organisation and tactics of fighter-bomber units. This precedes an analysis of close air support for mobile and airborne operations, the employment of fighter-bombers against German armoured forces, the employment of heavy and medium bombers in the close support role, the comparative effectiveness of fighter-bombers and ground artillery, and the effectiveness of fighter-bombers in the interdiction role.

The thesis argues that close air support did undoubtedly provide certain advantages. However, these became apparent as a result of the Allies possessing air superiority and, had Allied air resources been fewer, they would not have been in themselves sufficient justification for diminishing the tactical air offensive against interdiction targets, or the strategic air offensive against Germany.

INTRODUCTORY NOTE AND ACKNOWLEDGEMENTS

This study of close air support during World War II was made possible by my having been engaged as a researcher on the staff of the Department of War Studies, King's College London, contracted to provide historical data on the effect of air attack on ground forces for analysis by the Defence Operational Analysis Centre (D.O.A.C.) at West Byfleet in Surrey. Therefore I should like to express my gratitude to Professor Lawrence Freedman, Head of the Department of War Studies, Professor Brian Bond of the Department, and Mr. David Rowland of D.O.A.C., for this opportunity, and also to my tutor at King's, Dr. Philip Sabin, for his guidance throughout the years of study. Due appreciation is also extended to the Journal of Strategic Studies for publishing the material contained in Chapters Five and Six in the June 1991 and September 1992 editions respectively.

All judgements and opinions concerning the effects and utility of close air support in the period are my own, and should not be construed as reflecting in any way official views held by the Ministry of Defence.

CONTENTS.

GLOSSARY.

AACC ----	Army Air Control Centre (British). Joint RAF/British Army Control Centre for controlling air support.
AEAF ----	Allied Expeditionary Air Force.
AGRA ----	Army Groups Royal Artillery (British). Separate groupings of field, medium and heavy artillery usually under Corps control.
ALO ---	Air Liaison Officer (British). Army officer attached to RAF formation or unit for liaison duties.
AOP ---	Air Observation Post (British). Name given to squadrons of light aircraft piloted by the Royal Artillery, serviced by the RAF and employed in observing for the guns.
ASPO ----	Air Support Party Officer (USAAF). Pilot attached to U.S. Army Corps, Division, and Armoured Combat Command Headquarters as a liaison officer. (See TALO and TAPO below).
ASSU ----	Air Support Signals Unit (British). Communications units attached to Army and RAF formations for relaying air support requests and intelligence.
BAU ---	Bombing Analysis Unit.
CRA ---	Commander Royal Artillery.
DAF ---	Desert Air Force (RAF)
FAC ---	Forward Air Controller. RAF or USAAF officer, usually a pilot, attached to ground formations with the role of contacting aircraft and directing airstrikes from the ground.

FCP ---	Forward Control Post (British). An air support control post manned by RAF and Army personnel situated near the battlefront and responsible for controlling air support in a particular sector.
FOO ---	Forward Observation Officer (British). Artillery officer attached to an Infantry or Armoured battalion with a communications link to his artillery regiment or battery and able to call for and direct supporting fire.
GLO ---	Ground Liaison Officer (U.S. Army). Army officer attached to a USAAF unit as a liaison officer; the equivalent of the British ALO (see above).
IO --	Intelligence Officer.
MATAF -----	Mediterranean Allied Tactical Air Force.
MEW ---	Microwave Early Warning (Radar).
MET (or MT) -------	Mechanised Enemy Transport. Pilots' description of non-armoured enemy vehicles.
MORU ----	(i) Military Operational Research Unit (British). (ii) Mobile Operations Room Unit (British), an RAF operations centre responsible for co-ordinating the activities of bomber, fighter, and fighter-bomber Wings and allocating units for air support tasks. Employed by the RAF Desert Air Force in Italy, 1944/45.
NCO ---	Non Commissioned Officer.
OA --	Operational Analysis. (US)
OP --	Observation Post.
OR --	Operational Research (British).

ORB ---	Operations Record Book (British). Daily record of operations maintained by RAF Commands, Groups, Wings and Squadrons. Those relating to World War II are held at the Public Record Office, Kew.
ORS ---	Operational Research Section.
ORG ---	Operational Research Group (British).
PRO ---	Public Record Office (Kew).
RAF ---	Royal Air Force.
RP (or R/P) --------	Rocket Projectile (British). Refers to 3-inch rockets carried by Typhoon fighter-bombers.
RSD ---	Radial Standard Deviation. Measure of the scatter of bombs within a bomb pattern.
SA (OR) -------	Scientific Advisor (Operational Research).
SHAEF -----	Supreme Headquarters Allied Expeditionary Forces.
SOP ---	Special Observer Party. Operational Research Party set up to investigate the effects of various forms of Allied fire support upon the German coastal defences in Normandy.
TAC ---	Tactical Air Command (US).
TAF ---	Tactical Air Force (British).
TALO or TAPO -------	Tactical Air Liaison Officer or Tactical Air Party Officer (US), same as for ASPO above.
VCP ---	Visual Control Post (British). Control posts at the battlefront intended to direct aircraft from a point commanding a view of the battle area. See also FCP.
VHF ---	Very High Frequency.

INTRODUCTION

I. THE SCOPE OF THE THESIS.

The Object of the Thesis.

In 1946, shortly after the end of World War II, the British Army's Military Operational Research Unit (MORU) initiated a Battle Study with the object of determining the effectiveness of what had been an important feature of operations during the European war: close air support. While restricted to the campaign in North-West Europe in 1944-45, their study was intended to be comprehensive, embracing operations by the three aircraft types that had been employed to support Allied troops - heavy bombers, medium bombers and fighter-bombers. Whatever their initial hopes regarding the benefits of such a study, the MORU clearly found their task difficult and frustrating, for in the introduction to their eventual report they left the following warning for any future historian of close air support:

> *..there will be no records of the help it gave to the soldiers, no enemy documents to prove what it cost them in men and equipment, nothing, in fact, to judge the value of it all. He will, of course have*

glowing testimonies in plenty from Army Commanders, endless mention of the use of air support, and statements of enemy prisoners from Private to Field Marshal indicating how overwhelming and decisive was the air support. But if he is impartial he will remember, too, the tremendous bombings around Caen where it seemed that nothing could survive, and yet where the SS and parachute troops fought on as bitterly as ever. He will remember, too, how the Germans managed to stage an Army Group counter-attack in the Ardennes, almost without air support of their own, and he will remember those Germans, among them Rommel, who claimed that our air superiority was by no means the decisive factor in the North West European Campaign. He will find a surprising lack of concrete factual evidence with which to test the validity of these conflicting statements. He will be able to sum up only by saying, at greater or lesser length, that air support was immensely important, perhaps vital, but that sometimes it seemed signally to have failed, and that some people held that it was important perhaps, but not particularly so. 1

This statement, from a team of professional military analysts tasked with evaluating the utility and effectiveness of close air support, might suggest that the conclusion to any study of air support is certain to be equivocal. In his recent comprehensive history of battlefield air attack in the period 1911-1945, Richard Hallion echoed somewhat the MORU of 1946 when he wrote that,

Too often two equally fallacious viewpoints concerning battlefield air support have reigned: that air support has not been of significance to the land battle and that air support has been decisive in land warfare. The actual answer, of course, is in the middle. 2

As Hallion suggests, close air support has always been, and remains, a contentious subject, and objective conclusions about its advantages and

disadvantages are rare. Valuable studies have been produced, such as Hallion's and more recently by Peter C. Smith and that edited by Benjamin F. Cooling,3 tracing the evolution of air support theory and practice and developments in aircraft and weapons, but there has been relatively little attempt to determine precisely the advantages conferred upon troops in combat by the provision of close air support.

The purpose of this thesis is to correct this, from a historical standpoint, by addressing two fundamental questions within the context of the close air support provided for the Allied armies in the campaigns in Italy and North-West Europe in the period 1943-45. One is whether the employment of aircraft in the close support role provided sufficient military advantage at the battlefront to justify the associated expenditure of effort and the risk to aircraft and pilots other than in an emergency. Another is whether air support proved to be of more value when directed against targets beyond the battlefront, such as enemy communications, headquarters, and supplies. As this suggests, the question of close air support is essentially one of cost effectiveness.

Definition of Close Air Support

An evaluation of close air support during World War II must begin with a definition of the term in the context of its contemporary usage. The term 'Close Air Support' was in use during World War II, and in 1944 the RAF defined this type of air support as the immediate availability of aircraft,

> *..to attack and destroy, at the request of the army, targets engaging or being engaged by our front line troops, thus improving the tactical situation of the moment.*

This was in contrast to 'General Air Support', which was defined as,

> *..the attacking of targets, not in close proximity to our own troops, but immediately behind the enemy lines, so as to hamper, in due course of time, the fighting capabilities of the enemy front line troops. Road and rail blocking, demolition of bridges and tunnels, and the attacking of transport supplying the front line, would be included here.*4

A third use of airpower is known as 'Interdiction' - a World War II term remaining in use - which is defined as air operations intended to isolate the battlefront by destroying, disrupting, and delaying enemy forces, communications and supplies, often in areas far removed from the battle area.5 The 1944 concept of 'General Air Support' can be seen as interdiction in the tactical area, a mission approximating to, though somewhat wider than, the present concept of 'Battlefield Air Interdiction' (BAI).6 The subject of

this thesis is close air support, the meaning of which is the same today as it was in 1944,7 though for the purpose of comparative analysis attention is also given to what was identified in 1944 as 'General Air Support'.

The reason for selecting such a limited time scale as the campaigns in North-West Europe and Italy in 1943-45 was the need to be concise. Close air support became an important feature not only of Allied operations in Europe but also of those in the Middle and Far East and Pacific theatres. There is a plethora of close air support examples, and an abundance of data regarding the various methods developed for controlling and applying air support, and the aircraft, weapons and tactics employed. For the thesis to address in detail the questions necessary to arrive at firm conclusions, involving a comparison of the effectiveness of aircraft in alternative roles to close air support and also a comparison with artillery, a line must be drawn.

Moreover, the campaigns in Italy and North-West Europe offer several advantages to the historian. One is that they saw the culmination of air support theory and practice in the period, with the British and American forces employing the machinery and methods of air support that had evolved as the direct result of earlier experience and trial and error in previous

campaigns. Both campaigns also saw important innovations in the forward control of aircraft and in close air support tactics.

From the analytical point of view, these campaigns are important for two reasons. One is that air superiority enabled the Allies to employ their vast air resources, including heavy bombers of the 'strategic' air forces along with medium bombers and fighter-bombers, to influence the land campaigns without the complication of contending with major German air opposition. The importance of this was later expressed by Air Chief Marshal Sir John Slessor:

> *I remember my astonishment when I first arrived in Italy early in 1944 and realised the almost complete disregard in which the German Air Force was held: one hardly gave it a thought. In France and Germany the chaps on the ground were able to press on virtually regardless of enemy air activity, and with far fewer casualties than they had any right to expect.*8

Thus air support can be evaluated within the context of its employment on an unprecedented scale against an army which almost totally lacked air cover. The same could be said regarding the latter stages of the Far Eastern and Pacific campaigns after the demise of Japanese air power over the battlefronts and its concentration, like that of Germany, to protect the national homeland from strategic air attack. But in these theatres, while close air support was extensive, its effects could be dissipated by terrain and its

results are far harder to evaluate than on European battlefields.

The second reason relates to the problem of data availability regarding the effect of air attack. The campaigns in North-West Europe and Italy offer an advantage lacking in earlier Allied operations and, to a great extent, those in the Far East - or for that matter Axis close air support examples - and that is that by 1943-45 the scientific discipline of Operational Research, or Operational Analysis as it was styled by the Americans, had become an important feature of Allied warfare. The importance of Operational Research (OR) data to an analysis of close air support effectiveness cannot be overstated, and the overriding factor in selecting Italy and North-West Europe for analysis was the extent of OR conducted in these campaigns and its availability.

Operational Research Sections (ORS), composed of civilian scientists in uniform attached to Air Force and Army formations, investigated some of the most significant air support operations (including those in 'close air support', 'general air support' and 'interdiction') shortly after they had occurred. Their battlefield examinations and subsequent reports, compiled with the intention of assessing the effectiveness of weapons and tactics and containing interviews with Allied troops who had taken part and

also their German prisoners, are especially valuable. They do not provide ready-made answers to the fundamental questions regarding close air support that I have outlined - the MORU of 1946, who had access to this OR data, still found it difficult to arrive at definite conclusions, as the above quote reveals - but they do offer an alternative to the glib generalisations regarding air support which are to be found both in contemporary operational records and much subsequent post war historiography.

II. SOURCE MATERIAL.

Although OR forms the bedrock of the material used in this thesis, a study of close air support requires that the operational records of both Army and Air Force formations be consulted also. In addition to this primary source material, reference was made to a great deal of secondary literature.

Archival Sources.

It must be stressed at the outset that the thesis is based upon British records and such USAAF material as is available in the UK at the Public Record Office

(PRO) at Kew. Research committments and the time available have not allowed for an opportunity to examine the extensive data available to researchers in the United States, most notably the contemporary USAAF formation, unit and headquarters records which are held at the US Air Force Historical Research Center (USAFHRC) at Maxwell Air Force Base, Alabama. However, the extensive amount of British data, taken in conjunction with the considerable amount of USAAF material that is available at the PRO, enables this thesis to be an effective survey of close air support in the period.9

An important input to the thesis has been data from the German side. While, for the reasons given above, German archives have not been consulted, there is nevertheless much useful material available in the UK. The Imperial War Museum holds copies, some in translation, of the War Diaries and message logs of some of the principal German formations that fought in North-West Europe. Many of these are incomplete, but they yield useful information. In the post-war years the Air Historical Branch also compiled translations of contemporary German documents, some of the most useful being the weekly situation reports issued by German Army Headquarters (such as the Seventh Army in Normandy). In addition, Prisoner of War interrogation reports, many of them intrinsic to Allied ORS studies,

were consulted. Recent years have seen the publication of a number of detailed German unit histories, which provide an interesting, and often revealing, alternative perspective on many actions. All these sources have been helpful in providing an indication both of what it was like to be on the receiving end of Allied air attack and what such attack achieved, and they have been referenced throughout the thesis.

Extensive use has been made of the operational records of British Army and RAF formations now accessible to researchers at the Public Record Office. The War Diaries of British Army Divisions, Brigades, Infantry Battalions, Artillery and Armoured Regiments are to be found in the WO 171 files for North-West Europe and WO 170 for Italy. They contain a daily narrative of operations, though the amount of detail provided can vary considerably. However, these sources confront the researcher with a major stumbling-block in that, with relatively few exceptions, War Diaries at Battalion and Regimental level generally make little or no reference to how useful air support had been during particular operations. In fact War Diaries at this level often make little or no reference to air support at all. This can be frustrating, particularly when it is known that close air support was an important feature of the operation being researched.

War Diaries at Brigade and Divisional level are more useful. Daily Intelligence Summaries detailing each day's operations, usually compiled at Divisional level but occasionally also at Brigade level, invariably mention air support, and may give some indication of how useful it had been. Message Logs, usually contained in the War Diaries at Corps and Divisional level, can include messages from battalions reporting airstrikes on their front, sometimes indicating any noticeable effects but more often simply reporting that the bombs or rockets had been seen to fall in the target area. They can also be useful for giving an indication of timings, with the message requesting air support and that reporting the airstrike usually being recorded.

Useful sources of data to supplement material contained in War Diaries are published regimental histories. These also vary in the amount of detail provided, but the best of them are extremely detailed, describing events affecting the unit almost day by day. They have obviously used the War Diary as their principal source, but they often contain additional details and can be valuable for references to air support, and general comments as to how useful it had been, that may be lacking in a War Diary.

The operational records of the RAF are contained in the Operations Record Books (ORBs) maintained by RAF

formations at the following levels: Commands (AIR 23 & 24 files); Groups (AIR 25 files); Wings (AIR 26 files); and Squadrons (AIR 27 files). All contain a daily narrative of operations, an example being that compiled by RAF Desert Air Force in Italy, which provides detailed summaries of each day's activities and which is an essential source for a study of its operations (this is to be found in AIR 24). The ORBs of RAF Groups, and in particular the daily Intelligence Summaries to be found in the appendices to Group ORBs, can be quite detailed with regard to air support operations and usually record the number of sorties and aircraft losses.

The most detailed air accounts of particular close support operations are to be found in the ORBs of the squadrons concerned. These not only list the number of aircraft involved and any losses incurred but also contain the observations of the pilots who carried out the attacks and their assessment of damage and casualties inflicted upon the enemy - though often they were able to report only that their bombs or rockets had fallen in the target area. The amount of detail in squadron ORBs varies. In general those of squadrons which served in Italy are far more detailed than those of squadrons which served in North-West Europe. In addition, both Group and Squadron ORBs may include messages from Army formations expressing

gratitude for particularly successful air support missions, and these sometimes give an indication of the effect of the air attacks by recording the number of enemy dead and amount of destroyed or damaged equipment subsequently found by the troops.

Major operations, and some of lesser scale but which were particularly successful, were often the subject of separate Army and/or RAF reports. Most such operations involved close air support, and the reports are now to be found among the Headquarters papers of the Army and Air Force concerned. The reports are either straightforward narratives, or analyses. The latter are more useful, as some attempt was made to evaluate the effectiveness of the air support, and these were often carried out by Operational Research Sections. One example from North-West Europe of an operation given extensive coverage is Operation VERITABLE, which was the subject of separate reports by British 21st Army Group, the ORS of RAF 2nd Tactical Air Force, and No.84 Group RAF.

Contemporary RAF and British Army tactical memoranda and reports are an important source for how close air support operations were conducted. Numerous reports on the tactics employed by aircraft when attacking ground targets were compiled by the RAF in Italy and North-West Europe, and those compiled by the USAAF that are available at the Public Record Office have also been

consulted. In addition, there are studies by both the RAF and British Army detailing the organisation and method of operation of the systems for providing and controlling close air support employed in both theatres.

Comments on the campaigns and the air operations involved are contained in the Despatches of senior commanders, most notably the Notes for General Eisenhower's Despatch and the Despatch on air operations in North-West Europe by Air Chief Marshal Leigh-Mallory, both to be found in PRO CAB 106/980, and Air Marshal Coningham's Report on 2nd Tactical Air Force Operations from D-Day to VE Day to be found in PRO AIR 37/876. Also referred to was Field Marshal Alexander's Despatch on the Italian Campaign, a copy of which is to be found in PRO AIR 8/1790.

Published Primary Source Material.

Data can also be extracted from the published memoirs of former fighter-bomber pilots. These provide useful descriptions of tactics employed on close support missions, which are often a revealing contrast to the contemporary official RAF tactical studies mentioned above, and for their first-hand accounts of the hazards inherent in the low-level attack role. Those particularly useful regarding RAF operations in North-

West Europe were *Firebirds: Flying the Typhoon in Action* by Charles Demoulin,10 *Typhoon Pilot* by Desmond Scott,11 and John Golley's *The Day of The Typhoon*.12 A valuable compilation of Typhoon pilot memoirs is provided in *Typhoon Attack* by Norman Franks,13 while Christopher Shores in his book *Ground Attack Aircraft of World War II* includes an interesting synopsis of Typhoon tactics by the distinguished Belgian Typhoon pilot Colonel R.A. Lallement.14 Not surprisingly, these can give a somewhat biased view of the amount of destruction inflicted by Typhoon attacks. Bill Colgan's *World War II Fighter Bomber Pilot* provides an American perspective and is somewhat more balanced. It is especially valuable in being concerned with the Italian campaign, and Colgan includes a useful chapter relating his experience as a Forward Air Controller in Italy.15

For the chapter on the use of heavy bombers in the close support role an important source was the memoirs of the British Army's Liaison Officer at RAF Bomber Command Headquarters - *Soldier at Bomber Command* by Charles Carrington.16 This in turn indicated a number of contemporary reports on the subject compiled by Lieutenant-Colonel Carrington when serving in this capacity and which are now accessible at the Public Record Office. The autobiography of the Commander-in-Chief of RAF Bomber Command, *Bomber Offensive* by Air

Chief Marshal Sir Arthur Harris, was also consulted, as was that of Sir Solly Zuckerman.17 An important source detailing British Air Observation Post (AOP) operations, referred to in the chapter comparing fighter-bombers and artillery, was *Unarmed into Battle*, the history of the AOP by Major-General H.J. Parham and E.M.G. Belfield, originally published in 1956 but reissued in 1986.18

References to the employment of air support in North-West Europe are also to be found in the memoirs of senior commanders, examples being Eisenhower's *Crusade in Europe*, Montgomery's *Normandy to the Baltic*, and De Guingand's *Operation Victory*.19

Secondary Source Material.

Literature specifically on the subject of close air support in North-West Europe and Italy is scant, and the most useful overviews are those by Richard Hallion, who discusses support by heavy, medium and fighter-bombers in both campaigns in the relevant chapters of *Strike from the Sky*, and the work edited by Cooling, both referred to above. Two other extensive studies are invaluable sources for American air support operations in North-West Europe, and fortunately copies of both are available in the UK. One covers the *Effect of Air Power on Military*

Operations, Western Europe and was compiled by General Omar Bradley's Air Effects Committee of the US 12th Army Group in 1945. The other is *The Effectiveness of Third Phase Tactical Air Operations in the European Theater, 5 May 1944 - 8 May 1945* compiled by the US Army Air Force's Evaluation Board in 1946.

This Board was one of five such separate groups of officers assigned to the major theatres by the US War Department during the summer of 1944, tasked with preparing reports enabling assessments to be made of the effectiveness of USAAF training, doctrine, and organisation. After the creation of the Strategic Bombing Survey later that year, these boards concentrated upon tactical air operations. The board assigned to the European Theatre of Operations (ETO) was requested, in February 1945, by the USAAF Headquarters in Europe, to carry out an analysis of close air support or 'Third Phase' operations as this was styled. The result was the above report, completed in the summer of 1945, which drew upon data provided by US air and ground forces but which mainly reflected the experience of the US Ninth Air Force.

Both the above reports outline the air support system employed to support the US armies and also give detailed summaries of operations along with comments from US Army formations and also from German prisoners. These are contemporary historical documents

and could be described as primary source material; I have listed them as secondary sources because, as their titles suggest, they were attempts to analyse the effectiveness of air support. Copies of both are held at the Public Record Office.20

Detailed narratives of both campaigns were compiled in Britain after the war by the Cabinet Historical Section and the Air Historical Branch of the Air Ministry.21 The former are mainly narratives of ground operations and the latter of air operations, though both give details of air support. Recourse was also made to the British, Canadian, and American Official Histories of both campaigns.22 In addition, a number of relevant campaign histories were consulted. A major source for operations in North-West Europe is Chester Wilmot's *The Struggle for Europe*, while another is Milton Shulman's *Defeat in the West*.23

Sources used for Normandy included *Overlord* by Max Hastings, *Six Armies in Normandy* by John Keegan, and *Decision in Normandy* by Carlo D'Este.24 Max Hastings' *Das Reich* and Ralph Bennett's *Ultra in the West* give useful indications of the effect of air attack on German movement, the former detailing the experience of the 2nd SS Panzer Division during its move to the Normandy battlefront and the latter relating intercepted German signals traffic.25 Sources used for the latter part of the campaign in North-West Europe

included *The Long Left Flank* by Jeffery Williams, which one might describe as a semi-official history of the operations of First Canadian Army, and Major-General Essame's *The Battle for Germany*.[26] Both are written from the point of view of the soldier, and refer with acerbity to occasions when, in Army opinion, the Air Forces declined to provide a sufficient scale of air support.

The role of the Air Forces involved in both campaigns is well described in John Terraine's *The Right of the Line*, Roderic Owen's *The Desert Air Force*, and Christopher Shores' *Second Tactical Air Force*.[27] A greater level of analysis is provided in an immediate post-war study of the US 9th Air Force in North-West Europe - *Condensed Analysis of the Ninth Air Force in the European Theater of Operations* compiled by the Office of the Assistant Chief of the Air Staff in Washington in 1946. A copy is held at the Public Record Office.[28] For the chapter examining heavy bomber operations two sources giving statistical data on a daily basis for RAF Bomber Command and the US 8th Air Force were *The Bomber Command War Diaries* edited by Martin Middlebrook and Chris Everitt, and *The Mighty Eighth War Diary* edited by Roger Freeman, Vic Maslen, and Alan Crouchman.[29]

An important overview of the air war as a whole is Professor Overy's *The Air War 1939-1945*, while a

recently published (1990) general study of air bombardment in World War II is *Bombing 1939-45* by Karl Hecks.30 The latter covers tactical as well as strategic air operations, and summarises the developments in close support weapons and tactics by all the belligerents. Among the sources referred to for the fighter-bombers and artillery chapter two were particularly useful - *Gunners At War* by Shelford Bidwell, for its detailing of the evolution and employment of the method of fire control employed by British artillery in 1943-45, and *Fire-Power* by Shelford Bidwell and Dominick Graham for its discussion of the British air support system.31

III. STRUCTURE OF THE THESIS.

The thesis is organised into chapters addressing the following aspects of close air support.

Chapter I: Operational Research.

The first chapter is a discussion of Operational Research material, and focuses upon the Operational Research Sections that carried out the most significant work on close air support - No.2 ORS of

British 21st Army Group and the Operational Research Section attached to RAF 2nd Tactical Air Force, both in North-West Europe. The nature of operational research work is described, mainly by reference to the history of No.2 ORS compiled by its members shortly after the end of the war in Europe, and the chapter examines the limitations of OR data and its reliability.

Chapter II: The Air Support Mechanism.

The second chapter outlines the systems of command and control of close air support developed by the RAF and USAAF in Italy and North-West Europe. The most important theme is the extent to which air and ground forces co-operated despite both the RAF and USAAF having been opposed to the principle of close air support before World War II and during its early stages. The chapter examines just how smoothly this co-operation worked.

Chapter III. The Fighter-Bomber Weapon.

This chapter is mainly descriptive, intended to chart briefly the development of fighter-bombing as employed by the RAF and USAAF. The organisation of fighter-

bomber units, tactics, weapons and accuracy are discussed.

Chapter IV. The Flying Spearhead: Fighter-Bomber Support for Allied Mobile and Airborne Operations.

The fourth chapter assesses the effectiveness of aircraft in the role of 'flying artillery' by focusing on operations in which Allied troops had limited ground based firepower support. This embraces mobile and airborne operations. Regarding the former, the chapter discusses to what extent close air support by fighter-bombers contributed to maintaining the momentum of armoured thrusts. The American innovation of 'Armored Column Cover' and the British system of 'Cab-Rank' are discussed, and two British mobile operations, the initial stages of MARKET-GARDEN in North-West Europe and CYGNET in Italy, are examined in detail with the object of assessing the effectiveness of fighter-bomber support when closely integrated with an armoured thrust on a narrow axis of advance and a broad axis of advance respectively. A parallel is drawn with similar advances attempted when air cover was not available, such as the later stages of MARKET-GARDEN, and the chapter addresses the question of whether Armoured Column Cover and Cab-Rank

operations, even when successful, could justify the required committment of air resources.

With regard to airborne operations, the problem of providing air support for airborne landings is discussed with reference to operations in Normandy and at Arnhem, and comparison drawn with the later crossing of the Rhine.

Chapter V. Allied Fighter-Bombers Versus German Armoured Forces: Myths and Realities.

This chapter provides a historical perspective on a question which remains pertinent, namely whether it is cost effective to risk such high value assets as aircraft and pilots in attempts to destroy tanks at the battlefront. The chapter focuses principally upon the anti-armour operations by the Allied Air Forces in North-West Europe, and makes extensive use of contemporary ORS material in order to determine precisely how effective air attack was against armour. In particular, the chapter addresses such questions as whether the historically accepted view that large numbers of German tanks were destroyed by Allied fighter-bombers is accurate or largely a myth, and whether the value of air attack lay in its disruptive and morale effect rather than in the amount of destruction achieved.

Chapter VI: Heavy and Medium Bombers in the Close Air Support Role.

An important feature of Allied close air support in Italy and North-West Europe was the employment of heavy and medium bombers in the role. This chapter analyses the heavy and medium bomber support operations, drawing on the contemporary operational research by No.2 ORS in North-West Europe for data regarding ground surveys and comments by Allied troops. The effectiveness of these aircraft against various types of target is compared and the problems and risks inherent in employing the strategic bomber weapon in a tactical role are discussed. The chapter discusses whether senior Allied airmen were justified in their view that heavy bombers were not suited to the tactical role, and whether lack of success in some of the principal operations was the result of the military command lacking a clear appreciation of what heavy bombers could achieve and what was required of them - destruction or temporary neutralization of the target.

Chapter VII. Fighter-Bombers and Artillery: A Comparison of Effectiveness.

This chapter assesses the respective merits of fighter-bombers and artillery in close support, the comparisons being drawn with regard to responsiveness and cost-effectiveness. The chapter shows how the results of both comparisons favour artillery, and examines the reasons why, nevertheless, Allied troops often preferred fighter-bomber support. The methods developed for supporting ground attacks by artillery and fighter-bombers in Italy and North-West Europe are described.

The advantages of fighter-bomber attacks as they were perceived by Allied troops are examined, and the chapter also discussees the effectiveness of the methods pioneered in Italy of integrating air and artillery firepower upon specific targets, and what advantages were gained by this process.

Chapter VIII. The Cost Effectiveness of Close Air Support: A Comparison with Armed Reconnaissance.

This chapter examines the proportion of effort accorded by Allied fighter-bombers to their principal task other than close air support, that of Armed Reconnaissance. When flying such missions pilots were

directed to seek out and destroy targets of opportunity beyond the battlefront and at the same time to report any possible information with regard to the enemy ground situation. This was a highly offensive use of tactical air power and one of the most frequent tasks allotted to fighter-bomber squadrons. In the light of this, the chapter compares the effectiveness of fighter-bombers in this role with that of close air support, and also the losses incurred in both roles. The chapter discusses whether armed reconnaissance missions enabled the Allied Air Forces to exploit their resources to maximum advantage in support of ground forces by delaying and disrupting German movement and deployment.

The thesis concludes by summarising the contents of the individual chapters, and providing an overall answer to the questions raised earlier, namely whether the results achieved by aircraft flying close support missions justified the necessary expenditure of air effort and the risk to aircraft and pilots, and whether air support was of more value when directed upon targets beyond the immediate battle area.

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CHAPTER I. OPERATIONAL RESEARCH.

Introduction.

Operational Research is a scientific approach to the problems of determining the likely effects of weapons and tactics and of deciding between varying courses of action, the main object being, according to Professor P.M.S. Blackett, to *'find a scientific explanation of the facts'*.1 As a prelude to a fuller discussion of the OR material consulted for the thesis, it is useful to sketch briefly the wartime development of British Operational Research.

I. THE NATURE OF OPERATIONAL RESEARCH.

OR had proven of value during World War I, an example being the substantial amount of research conducted by Viscount Tiverton for the Royal Naval Air Service and the Air Department,2 and its potential was appreciated from early in World War II. In September 1940 Professor Blackett, Scientific Advisor to the Army's Anti Aircraft Command, formed a small

group of civilian scientists to study the technical problems of anti-aircraft defences, particularly that of introducing Radar gun-laying. In March 1941 Blackett left to conduct OR for RAF Coastal Command, and he eventually became the Admiralty's Director of Naval Operational Research. His departure left the future of Army OR uncertain, as there was no mandate for expanding the work of his group.3

This changed after May 1941, when the distinguished physicist Sir Charles Darwin was appointed as Scientific Advisor to the Army Council. Darwin was committed to OR, but had to counter opposition from directors of the Army's various branches to what they saw as scientific interference in operational matters.4 However, by August 1941 an enlarged Army Operational Research Group (AORG) had been created under the command of Lieutenant-Colonel Basil Schonland, the South African physicist. This was intended to serve both the Ministry of Supply and the War Office, the former with regard to research in the UK, and the latter for research overseas.

It was also intended that Operational Research Sections should be formed for service overseas, though this question was not raised until the summer of 1942. Finally, on November 26th 1942, a decision was made to establish ORS for overseas theatres and an establishment for a pool of 36 officers - on the basis

of 6 for an estimated six theatres of war - was planned. It is interesting that at this stage there was considerable War Office concern about whether a total of 36 suitably qualified officers could be found, whereas by 1945 a total of no less than 120 officers had served with Army ORS. 5

ORS In The British Army and RAF.

The first ORS sent overseas was posted to the Middle East in the summer of 1942 and attached to General Headquarters in Cairo. It encountered the problem that all subsequent ORS were to contend with - the reluctance of operational commands to allow civilian scientists - even if they were in uniform - to conduct work in the battle zone. When it was suggested that the section investigate the effectiveness of anti-tank guns, the response from Eighth Army was that this would necessitate study in the battle area, and that *'..no officer from GHQ, except the Commander-in-Chief, could visit the battle area.'* 6

Nevertheless, ORS continued to be prepared for service overseas and on May 24th 1943 No.1 ORS was established and mobilised the following month, eventually serving in Italy. On August 14th 1943 No.2 ORS was formed, for eventual service with 21st Army Group in North-West Europe. These ORS attached to

armies in the field were intended to provide scientific assistance to the Commander in four respects as follows:

a) Advice and assistance in the solving of technical problems arising during operations and advice as to the best use of available equipment.

b) Analysis of the performance of weapons and equipment in battle.

c) Assistance in, and analysis of, trials of British and captured enemy weapons and equipment.

d) Assistance with any problems which arose requiring a scientific approach to their solution.

The composition of ORS varied according to theatre, but there were important common features. One was that an ORS was led by a Deputy Director of Scientific Research. The leader had to be a scientist to fully appreciate the scientific potential of the ORS and the nature of the problems with which it had to deal. He was also accorded the rank of Colonel so that he had the necessary status to tender advice in the absence of a Scientific Adviser. Another common feature was that an ORS usually contained at least one competent statistician and, when manpower permitted, a number of NCO's (Sergeants) for the task of data collection and an adequate clerical staff. Finally, a basic - far from lavish - scale of transport was allocated to enable the ORS to operate as a self-contained unit.7

The RAF appears to have a more positive attitude than the Army to the utility of OR, and ORS were attached to all the operational RAF Commands. The ORS attached to RAF 2nd Tactical Air Force in North-West Europe originated in a decision taken in 1942 to create an ORS for Army Co-operation Command, at that time the only RAF formation responsible for practising the weapons and methods of close air support. The ORS consisted of two scientific officers and six junior scientific officers - all of whom had been recruited from ORS Fighter Command - with Mr. Graham, another physicist, appointed as officer-in-charge. Close contact with the AORG, particularly those concerned with air support problems, was maintained from the outset.8 In June 1943, Army Co-operation Command was redesignated the Tactical Air Force (TAF), and by the end of the year ORS TAF - as the ORS had become known - became absorbed by the new ORS Allied Expeditionary Air Force (AEAF) created in December under the direction of Mr. Larnder of ORS Fighter Command who was appointed Scientific Adviser (Operational Research) or SA(OR).

ORS AEAF was a self-contained branch of the Air Staff at Headquarters AEAF and had two main functions: to advise the Air Commander-in-Chief on scientific matters affecting operations, and to carry out investigations and analyses for the various

Headquarters branches.9 Anxious to maintain the identity of an ORS TAF which would be concerned with problems affecting air-to-ground operations, Mr. Larnder formed a section which became known as ORS 2nd TAF composed of the original ORS TAF members and which remained under the control of Mr. Graham. Two members of ORS 2nd TAF were attached to each of the composite groups of the Tactical Air Force, while Mr. Graham with one assistant spent most of their time at Headquarters 2nd TAF. Scientists attached to ORS AEAF were granted honorary commissions, Larnder being accorded the rank of Group Captain and Graham, commanding ORS 2nd TAF, that of Wing Commander. ORS personnel serving overseas wore RAF uniform. 10

Reference To Operational Research Data.

The OR material referred to in the thesis is, for the most part, that compiled in North-West Europe by the British Army's No.2 ORS attached to 21st Army Group and the ORS attached to RAF 2nd Tactical Air Force (ORS 2nd TAF). To a lesser extent, reference is also made to reports compiled by the British Army's No.1 ORS in Italy and the ORS attached to RAF Desert Air Force in that campaign. Reports compiled by the ORS of the US 9th Air Force in North-West Europe have also been consulted. The predominance of data from No.2 ORS

and ORS 2nd TAF reflects the fact that they were responsible for the most important work on close air support. In contrast, of the fifteen reports compiled for Eighth Army by No.1 ORS in Italy, no less than twelve were concerned with problems regarding the accuracy and effectiveness of artillery fire.

No.2 Operational Research Section.

That No.2 ORS carried out work on close air support at all was the result of accident rather than design. To make full use of the data compiled by No.2 ORS, and to understand its value and its limitations, it is necessary to have an idea of how the Section worked.

There are two important factors to consider. First, the size of the ORS throughout the campaign was always a limiting factor to the amount of work that could be done. Before D-Day the Section consisted of five officers, three drivers, a clerk, one jeep and two 15 cwt trucks. When provision was made to increase the Section, this only amounted to three more officers, an extra jeep, a staff car, and a few more other ranks. Second, the work carried out by the ORS was not systematic - it had no clear brief of what aspects of warfare to investigate. As will be seen, the ORS exercised remarkable iniative regarding the selection of problems to be investigated.

The Section did not go to Normandy as a unit but in instalments. One member, Lieutenant-Colonel Johnson, went to France on D-Day as Radar Adviser to the Anti-Aircraft Brigade, with which he spent the following three weeks evaluating the performance of equipment. Next to reach Normandy was Major Fairlie (Royal Canadian Artillery) who was attached to the Special Observer Party (SOP), a group formed shortly before the assault to study the effects of different forms of attack on the German coastal defences. The SOP spent two weeks working among the beach defences, and it was at this time that the first indication of an important aspect of OR work was given. It was found that,

> *Whatever induced the Germans to give in, it was not physical destruction of their fortifications, for of this there was little or none, despite the huge naval and air bombardments.*||

This suggested that the 'morale effect' of bombardment had been the decisive factor, and as this is a vitally significant aspect in the evaluation of the effects of close air support it is important to define it. It is a term used rather loosely in contemporary OR to refer to troops under air or artillery bombardment being prevented from manning their weapons, moving, and functioning effectively not only during the bombardment but for varying periods of time afterwards. It was a phenomenon never fully understood and impossible to quantify. The SOP made no

attempt to evaluate it, being concerned only with the physical effects of bombardment, and No.2 ORS did not address the problem until August 1944, the history of the Section observing that:

> *To assess the morale effect of a bombardment was...to attempt an utterly new analysis; though there were many who had suggested doing it, there was no one who had ever tried.*12

No.2 ORS took shape in Normandy towards the end of June when the advance party of two officers (Majors Swann and Sargeaunt), a truck, a jeep, and two drivers landed. This was a week later than intended due to an inauspicious start - the Landing Craft transporting them to France had become separated from its convoy, wandered far off course, and was only saved from entering the Atlantic by taking a line from a passing German V1. After landing in the American sector, the Section moved to Cruelly, the location of British Second Army Headquarters. The staff of Second Army clearly had little idea of how to employ the ORS or how it could be useful - an enquiry by the Section regarding what was required of them,

> *..though it met with every courtesy, gave us no more idea of what we might do nor where we might start.*13

On their own initiative the Section members began to visit the front line to view combat at close range - a task for which their few jeeps proved invaluable. From these visits a number of projects suggested themselves: the need to find a method of locating

German mortars which were causing heavy casualties and which were proving very difficult for the Army to deal with; the distribution of hits and penetrations in British and German tank casualties and their influence on tactics; the best method of using the PIAT (Projector Infantry Anti Tank) infantry anti-tank weapon - which although often fired rarely hit a tank - and the problem of the Normandy dust which was rapidly wearing out fighter aero engines at the forward airstrips.

The somewhat haphazard nature of OR at this stage is shown in that the Section initiated work on these problems without directives from above, but shortly afterwards the problem of dust became the responsibility of the RAF, and the PIAT that of the Army's Weapons Technical Staff. Nevertheless, the Section proved its worth with the mortar location and tank casualty surveys. Both required the collation of much data and were not completed until August, but the former (Report No.11) became the basis of a counter-mortar organisation in 21st Army Group and the latter (Report No.12) proved to be the first study to provide accurate data on how armour should be distributed on tanks fighting in close terrain.

In the meantime, the Section had embarked, equally by chance, upon its extensive work on close air support - initially regarding that by heavy bombers.

On July 7th 1944, for Operation CHARNWOOD, RAF Bomber Command attacked the Northern outskirts of Caen, and nothing shows the spirit of OR and the iniative exercised by the Section better than their own decision to investigate this operation:

> *..it occurred to us to wonder what this immense effort had...achieved. Conflicting stories abounded, and neither the RAF nor the Army seemed to have any clear idea. Without any directive from above and, with the object more than anything else of satisfying our own curiosity, we set to work to find out what had really happened.*14

Three members of the Section spent several days amid the ruins of Caen, interviewing troops who had taken part and civilians. Their Report (No.5) was forwarded to 21st Army Group Headquarters, but the OR team were far from proud of it and only too aware of its limitations:

> *...to our minds it was not satisfactory, since its conclusions were...indefinite and negative...we had made no serious attempt to study morale effects, we had not considered the possibilities of prisoner-of-war interrogation and we had paid quite insufficient attention to its effect on the progress of our own troops. The report was...little better than a study of the plain physical effects of the bombing.*15

Nevertheless, the report was received with interest at 21st Army Group, particularly by Brigadier Schonland, by then its Scientific Adviser. Some two weeks later, at the start of Operation GOODWOOD, Schonland sent an urgent telegram to the ORS asking them to report on that and all subsequent heavy

bombing operations. Report No.6, on GOODWOOD, was equally unsatisfactory in the opinion of the ORS,

> *..we started too late, the battle was too big for the small numbers of the section, and many of the bombed areas were still in enemy hands at the end.*16

In the analyses conducted after GOODWOOD, the ORS tried to ensure that work started in good time, that Operation Orders were examined, and that the course of the battle was closely monitored. It was this work on heavy bombing that set the pattern for most of the Section's subsequent work in the campaign:

> *..our work developed into the search for means to reconstruct and analyse particular battles. Once the missing elements of the battle had been supplied, suggestions for improvement followed; once, for instance, the real value of a particular air attack had been determined, it was not difficult to say whether another type of attack would have been better.*17

Between July 30th and August 20th 1944 No.2 ORS completed five reports on heavy bombing, the first concerning Operation BLUECOAT for which the planning and course of the battle were studied in detail, casualties analysed, and interviews held with troops who had taken part. In the opinion of the ORS this report (No.7) was the first to indicate clearly the value of the bombing, though it still lacked prisoner interrogation. It was followed by No.8, on TOTALISE, and No.9 on the effects of short bombing of friendly troops. An idea of the work and method involved in the compiling of these reports, particularly in that the

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ORS had to commute considerable distances to the front line from where they were based, is given in the Section's history:

> *Studying these Heavy Bombing attacks was a laborious and depressing affair, and at the time we prayed that we should never have to do any more of it. The dust and the appalling quantities of traffic...made travelling to and fro an exhausting business. Having arrived at the front, we had to probe about in the desolation of one French village after another, often uncomfortably close to mortaring, shelling, and the front line, and search out from their hiding places units who had taken part in the battle. When we returned there were air photographs to be pored over, and a thousand and one fragments of information to be assembled.*18

By this time the Section's work regarding air support had been extended. Shortly after GOODWOOD, and as a result of an arrangement made by Brigadier Schonland with the Air Branch at Headquarters 21st Army Group and ORS 2nd TAF, Major Pike, who had been recalled from No.1 ORS in Italy, arrived from England with a further jeep and driver. His task was to study the effects of fighter and fighter-bomber support attacks. As the history of the Section points out,

> *..it was lack of knowledge which prompted the work, and indeed, so great was the lack of knowledge of the effects of air attack, that a very large proportion of the Section's efforts, possibly an undue portion, was devoted to this one subject.*19

In fact the question of fighter and fighter-bomber support was causing considerable rancour between the RAF and Army. Claims for the destruction of ground targets were being submitted by pilots which the Army regarded with disdain. Schonland, and particularly

Montgomery's Chief of Staff, De Guingand, needed to know the truth.20

Major Pike's first report (No.3) analysed an attack by RAF Typhoons on a German column, and was the first case of its kind ever to be fully examined and documented. His next report (No.4) was far more extensive and concerned the effect of attacks by RAF rocket-firing Typhoons against the German armoured counter-attack at Mortain. Both reports and their conclusions are discussed in Chapter V concerning air attack upon armour, but in the context of the work compiled by No.2 ORS the Mortain report amounted to the first occasion when attention was drawn to the discrepancy between air force claims of destruction and the evidence found on the ground. Consequently the report caused much controversy, and though ORS 2nd TAF also examined the battle area and found the same evidence, Pike's report was rejected by Headquarters 2nd TAF.

This was only the start of the analyses of fighter-bomber attacks by No.2 ORS. Shortly after the closure of the Falaise 'Pocket' the Section was directed to the area in order to discover precisely what the Air Forces had achieved during the German retreat. This resulted in the most momentous work of the Section, and it is worth quoting from the Section's history which observes that:

*From the historical point of view, Report 15 'Enemy Casualties in Vehicles and Equipment during the retreat from Normandy to the Seine' deserves to be considered as our best work. Into the making of it went the effort of six of us for three weeks, and of one or two for many weeks more. We examined vehicles individually, we counted them in bulk, we interrogated the local French population, we interrogated prisoners of war, we used the reports of aircraft reconnaissance and we examined air photographs. Accepting the limitations of time, there was probably little more we could have done in assessing physical destruction; but we often wished that we had done more on the effect of the Air Forces in causing panic and confusion amongst the enemy.*21

The result was further controversy with the RAF, as the Section concluded that the Air Forces, despite the destruction that they had inflicted, had failed to achieve effective interdiction and should have been more systematic in their attacks. This is further discussed in Chapter V.

In September 1944 the Section had the opportunity to assess the effects of heavy bomber, medium bomber, and fighter-bomber attack all within the context of one operation - the assault on Boulogne. The Section arrived outside Boulogne some days before the assault and so, for the first time, were able to prepare their investigation in detail beforehand using maps and plans. They observed the assault as it progressed, interrogated prisoners as they were brought in and, after the assault, discussed the operation in detail with the Canadian battalions involved. The resulting report (No.16) was the most complete attempt at

assessing a battle achieved by the Section during the campaign, though the analysis of the effect of artillery and tanks was acknowledged to be far less detailed than that of air attack due to lack of time. Indeed, the extensive coverage accorded Boulogne prevented the Section from covering - except for a cursory look at the effects of air attack on gun positions - the subsequent assault on Calais.

For much of the autumn and winter of 1944-45 the Section, based in Brussels, was employed in addressing problems related to artillery. Their most important work in this field, regarding the morale and destructive effect of artillery bombardment, was achieved at this time (see Chapter VII below). However, in January 1945 the Section was once again called upon to investigate air matters as a result of the German Ardennes offensive. As in Normandy, Allied fighter-bomber pilots were submitting claims for the destruction of German armour which were described by Army Headquarters as 'extraordinary' and, as at that time the US First and Ninth Armies were under the command of 21st Army Group, No.2 ORS was directed to *'find out what was really happening'* as a high priority task.22 In order to avoid the differences of opinion with the RAF that had occurred in Normandy, the Section was this time directed to work jointly

with ORS 2nd TAF. The history of the Section observes that,

> *Joint efforts are usually difficult, and ours were no exception. But by having members of the Air Force O.R.S. to live with us, and by thrashing out reports together, we always reached agreement in the end.*23

Consequently a combined team of eight, including Wing Commander Graham and Squadron Leader Abel of ORS 2nd TAF, was based at Aywaille in the Ardennes salient from where they carried out an extensive ground search for destroyed tanks claimed by the Air Forces. In contrast to their earlier work in Normandy, the ORS were hampered by adverse weather, extreme cold and occasional blizzards, and the fact that much of the ground was covered in snow which prevented tanks from being seen from more than a few yards away. The investigation was therefore slower, and was acknowledged to be less thorough. There was little opportunity to assess RAF attacks as the RAF had not carried out much anti-tank activity, but with regard to the activities of US fighter-bombers the same problem that had been first discovered in Normandy was found: overclaiming. The ORS reported that,

> *For every hundred claims, we could only find one tank indubitably destroyed by air: and, though a few cases turned up where perhaps tanks had been abandoned because of air attack, they were doubtful and went only a very little way to making good the discrepancy.*24

This investigation resulted in the first Army/RAF ORS joint report, which in turn suggested the need

for a fuller study of the role of the Air Forces in defeating the German counter-offensive. A few days after the completion of Joint Report No.1 on aircraft versus tanks, members of both ORS began to investigate the result of air attacks against the major communications centres in the salient. By ground examination, and extensive interviews with the local Belgian population, a detailed analysis was compiled of the delay and dislocation caused to the Germans by air attack - the result being a comprehensive report by ORS 2nd TAF on the role of the Allied Air Forces in stemming the German thrust. Further joint reports consisted of a valuable assessment of the effectiveness of rocket-Typhoons in the close support role, for which many German prisoners were interrogated and extensive interviews conducted with British and Canadian troops, and an analysis of the effectivenes of German flak and Allied counter-flak measures during Operation VARSITY, the airborne assault across the Rhine. All these reports have been consulted for this thesis.

Activity of ORS 2nd TAF.

As No.2 ORS and ORS 2nd TAF collaborated very closely in the final months of the campaign, it is important to sketch the activities of the latter.

Unlike their Army equivalent, ORS 2nd TAF was never a compact body. Before D-Day the commander of RAF 2nd TAF, Air Marshal Coningham, refused to allow scientists as members of his Headquarters staff and only eventually was he persuaded to allow Wing Commander Graham and his assistant to accompany his Headquarters to France. Although ORS members arrived at 2nd TAF Headquarters at Le Tronquay on August 4th 1944, it was only after AEAF ceased to exist in October 1944, with the consequent disbanding and relocation of personnel of ORS AEAF, that ORS 2nd TAF came into its own. On October 22nd ORS 2nd TAF, located in Brussels, was reorganised as a team of 15 scientific officers but these were widely distributed throughout 2nd TAF: two were attached to Headquarters, one each to No.2 Group and No.34 Photographic Reconnaissance Wing, two each to No.84 Group and No.6 Film Processing Unit, four to No.85 Group, and one each to Armament Practice Camps. Two further officers were attached to the Bombing Analysis Unit (BAU) recently formed under SHAEF.25

Such dispersion made it difficult for ORS 2nd TAF to carry out investigations in the manner of No.2 ORS because they simply could not concentrate officers to deal with a single problem. Had it not been for the centralised organisation of No.2 ORS, the later joint investigations would have been impossible. It was for

this reason that the most important work on air support - for example the investigation of the Falaise 'Pocket' - had to be left to the Army. Nevertheless, ORS 2nd TAF managed to conduct some valuable analyses of close support operations, most notably the effect of air attacks on gun positions and strongpoints, and to accumulate much data on fighter-bomber tactics and accuracy.

II. THE IMPACT OF OPERATIONAL RESEARCH.

While the value of wartime ORS material to the historian is unquestionable, it is interesting to discover the extent to which it was acted upon at the time by those for whom the reports were compiled. In fact the evidence suggests that the impact of OR at the operational level was slight.

Army and Air Force staffs appear to have held their OR Sections useful for answering questions considered relevant to the sphere of scientific advice, an example being the question submitted to No.2 ORS by the staff of 21st Army Group during the planning of Operation VERITABLE enquiring whether the use of aircraft bombs in the battle area would crater the wet

ground and render it impassable for tanks. Moreover, as the experience of No.2 ORS shows, they could also be employed to resolve questions such as the accuracy of fighter-bomber pilot claims of German tank destruction. Such problems were obviously appropriate for the ORS to deal with, but the broad analysis of battles conducted by the ORS also led to conclusions as to the best use of weapons and appropriate tactics. When this type of data, and suggestions, were submitted they were often either unwelcome, or simply not acted upon.

There were two reasons for this. One was that senior Military and Air Force commanders did not appreciate being told how to conduct their operations - as No.2 ORS discovered. After their extensive field work investigating the heavy bomber operations the Section decided to compile a general report (No.14) on the use of heavy bombers to support the Army which was duly forwarded to 21st Army Group. Their history records that,

> *It had been intended as a simple guide, but was vetoed as being too contentious and outspoken.*26

Clearly, as far as 21st Army Group was concerned, the ORS had exceeded its brief.

The second reason was that there was simply no mechanism for ensuring that senior commanders, or their subordinates, were made aware of the results of

ORS studies. Thus the potential usefulness of ORS material was often not realised even when it was circulated. The outspoken history of No.2 ORS describes how this situation arose:

> *...often we felt infuriated and frustrated to find our ideas not adopted because reports had never been circulated, or because they had never been read. Much of the trouble lies in the fundamental paradox of the military system: although at the highest formation there is most likely to be the time and temperament to appreciate O.R.S. reports, the opportunity to act on them is in fact least. Although the last say always rests with the top, as regards ways and means of fighting, their influence is remote and their control far less than they may care to admit. The lower formations have the power to act, but less time and less inclination to think, so that O.R.S. reports tend to be regarded as yet more paper from above, and are treated accordingly...*
>
> *...we came up against the inescapable fact that the introduction of new ideas rests solely with a commander...We thus found ourselves trafficking in ideas far above our rank, with report-writing as the only ready means...of conveying them...Many of the ideas that emerged from our reports were never adopted, often never even considered, because they were only ideas buried in reports that were never read.*[27]

A contributary factor may also have been the extent to which the ORS themselves decided what should be investigated, as they lacked specific instructions as to what was required. To quote once again from the history of No.2 ORS,

> *..often we were given no directive at all. "See what you can make of air attack in the Falaise pocket". "Have a look at the Assault on Boulogne" or "Follow the armoured drive" were all the direction we ever received for some of the most successful of our reports.*[28]

Such a method permitted great freedom of action, and fostered an independence of spirit. This is seen in an example from towards the end of the Normandy campaign, when the Commander of No.2 ORS suggested to the 21st Army Group staff that a member of the Section should accompany the armoured drive through Northern France and Belgium. When asked by the staff what it was proposed that this officer should do,

> *..the Commander replied that it would be up to the officer to find out what would be best for him to do when he got there.29*

The detachment was authorised, and some valuable work resulted, but this shows how, in a sense, the ORS were responsible for identifying the need for their own work - it was very easy for such work to be unappreciated by those for whom it was carried out if the latter did not comprehend the need for it in the first place. The example also shows how iniative and practicality were vital characteristics of the OR worker, and illustrates the point made in the post-war history of OR in the RAF - that while scientific training was necessary (some of the best OR members being engineers or physicists), not all scientists could grasp the principles of operational research.30

Reliability of OR Data.

An important question concerning OR field work is the extent to which the conclusions reached by the ORS could be be regarded as reliable, either by military commanders then or by historians now. Regarding close air support investigations a salutary warning, based on the experience of ORS 2nd TAF, is given in the post-war history of wartime OR in the RAF:

> *The assessment of air attacks in close support of the Army was not easy. Relevant information was gathered from a variety of sources - interrogation of prisoners of war, study and analysis of intelligence reports, discussions with Army and Air Force officers, and ground surveys of battlefields after capture. Although much interesting and useful information was gathered, this was not available in sufficient detail and did not cover a sufficiently wide range of operations to form the basis for quantitative study..*31

Most OR data was certainly based upon particular examples, and this is true of the work of both No.2 ORS and ORS 2nd TAF. Moreover, the few ORS and the small number of scientists in each could not cover a wide range of operations in detail and, as related above, when an attempt was made by No.2 ORS to cover a particular operation in depth some aspect had to be skimmed or neglected altogether due to the volume of work and the pressure of time. Attempts to cover one operation meant that other similar ones could not be studied except in the most cursory sense. Nor, in the experience of No.2 ORS, was OR field work very

systematic. As they were attempting much that was unprecedented, there was little direction from higher authority as to what to look at and what to look for; it was a continuous process of discovery determined largely by the initiative of the ORS members themselves. The danger here was that the theoretical aspect of OR work may have been compromised by the ORS, necessarily examining problems at very close range and being unable to cover many such operations in detail, here failing to perceive a larger perspective.

Nevertheless, in a practical sense the OR reports hold much that is of value - particularly the ground surveys conducted shortly after operations, during which the ORS examined destroyed and damaged vehicles and equipment, and recorded the number of shell, bomb and rocket craters in the area and their position. In the case of anti-armour operations by Allied fighter-bombers, these provide physical evidence to set against what otherwise would be misleading claims of destruction. These reports can be considered reliable in the attribution of causes of destruction and damage, for it was not difficult to determine whether tanks and vehicles were destroyed by air or ground weapons, and where there was doubt this was indicated by the ORS. The same is true for the reports examining attacks by fighter-bombers against gun positions and

strongpoints, the damage by air weapons being sufficiently obvious to leave little room for doubt.

The investigations of the heavy bomber operations were more complicated. Assessments of the destruction of targets in fixed defence positions, such as gun positions, can be considered accurate - particularly at Boulogne where No.2 ORS, instead of appearing shortly after the operation, were on hand to witness it. It was far harder to evaluate the effect of the bombing in field operations after the ground had been much fought over, and when some of the bombed areas remained in enemy hands. To a greater extent in these operations than in those of fighter-bombers against armour the amount of destroyed equipment and the number of enemy casualties found is more likely to reflect precisely that - the amount found rather than that inflicted. In particular the level of casualties caused to German troops as a result of heavy bombing remains, to some extent, questionable.

No.2 ORS found very few German dead after some of the heavy bomber support operations in Normandy, and concluded that such bombing against troops well dug-in did not produce heavy casualties. Taken all round the evidence from such operations supported this view, but the ORS also acknowledged that during one of these investigations a captured German medical officer told them that the Germans always removed their dead before

the arrival of Allied troops. They were disinclined to believe him, not only because they thought him an arrogant type whose information was considered unreliable, but also because they felt such a step would normally be impracticable.

Yet in this they were wrong for, when possible, German troops did follow a policy of taking their dead with them when falling back from positions in order to prevent their discovery by the Allies. It seems odd that the ORS were not made aware of this, for the practice should have been known to Military Intelligence as it had been discovered in earlier campaigns. For example, towards the end of the fighting in Tunisia, the British 26th Armoured Brigade captured a number of German troops of the Herman Göring Division, one of whom remarked to his captors that:

> *That stupid order to carry back all our dead with us had a very bad effect on the morale....you can't keep cheerful and sing with a lot of bodies piled on the gun carriage.*32

Thus there are pitfalls to drawing conclusions from the evidence discovered by the ORS in the battle area, and when using ORS data it must be remembered that the theoretical aspect of their reports, such as the level of casualties inflicted by various methods of attack against different targets and suggestions as to the best method of employing heavy bombers and fighter-

bombers in the close support role, were based on deductions made from the evidence available to them. The historian should not regard this evidence as incontrovertible, any more than could the ORS investigator of 1944.

This does not detract from the great value or OR material in that, despite its limitations, some attempt was made *at the time* to find out what happened and why amid the chaos of battle. The ORS were on the scene shortly after the conclusion of operations, and sometimes while they were still taking place, and were able to talk to the troops that had taken part while memory and experience remained fresh. Few historians can doubt the worth of having such data as the comments of the British and Canadian infantry officers, given soon after the operation, as to why the heavy bombing during CHARNWOOD was of little use to them, the comments of the British tank crews regarding the difficulties of their advance during GOODWOOD, or the descriptions given to an ORS officer by the commanders of American infantry regiments of how fighter-bombers had assisted them at Mortain.

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CHAPTER II.

FLAWED INSTRUMENTS.

THE ALLIED AIR SUPPORT SYSTEMS, 1943-45.

Introduction.

Close air support requires aircraft to become battlefield weapons, but their success in this role depends upon the solution of a considerable command and control problem. There has to be a system enabling troops to request air support, for processing such requests and forwarding them to the air force, for allocating air units in response, and for directing them to the required area of the battlefront. Aerial firepower, when directed at battlefield targets, must be integrated with the fire and movement of friendly ground forces. Finally, this entire process must be carried out as quickly as possible if the air support is to be of use to those requesting it. Close air support thus requires the creation of an extensive and elaborate joint army/air force machinery for carrying out these various functions, employing considerable manpower and equipment resources.

The purpose of this chapter is to determine the success of the British and American ground and air forces in solving this problem in Europe in 1943-45. While largely descriptive, the chapter shows how effective air support ultimately depended upon the constant acquisition and rapid dissemination of data and of instructions based upon it, and on the extent of cooperation achieved between ground and air forces. A study of historical data suggests that with regard to the former the Allied air support systems were generally successful, but that deficiencies in the latter significantly reduced their potential effectiveness.

I. THE BRITISH AIR SUPPORT SYSTEM.

The System in Outline.

Having firmly rejected the concept of close air support during the interwar period, in 1939 the RAF possessed no close air support doctrine, no aircraft suitable for the task, and there was no joint RAF/British Army system of air support. Only in August 1940, after defeat in Norway, France and the Low Countries and with Britain under threat of invasion, was the first step taken to create such a system. The

War Office sanctioned a number of air support experiments that were conducted the following month in Northern Ireland under the direction of Group Captain Wann and Colonel Woodall. The resulting 'Wann-Woodall Report' had clearly absorbed the lessons of the *Blitzkrieg* by identifying the need for a tactical air force - an RAF formation equipped and trained both to obtain air superiority by offensive air action and to attack battlefield targets in close coordination with ground operations.1 For the latter task the experiments in Ireland saw the birth of the system which, when refined, was that employed by British forces in 1943-45. It was, as Charles Carrington describes,

> *..a signals network which sent out what Woodall called 'Tentacles', army officers in light cars, who went forward to the leading troops and signalled back requests for air support, by wireless links that avoided the normal channels, directly to a control centre, where they were monitored by Army and Air Force Staff Officers, sitting together.2*

The system was adopted in principle by both the RAF and Army and was set up for trials. The outstanding feature was its extensive communications network, the most vital factor in any air support system, and which even in the experimental stage was found to cut by hours the time hitherto required to arrange air support.3 The emphasis was placed on joint RAF/Army planning and decision making; Army and RAF Group headquarters were located together and the joint

control centre, known as the Army Air Control Centre (AACC) with its own updated battle situation maps and charts of aircraft readiness, was situated as a quadrangle of caravans each connected by telephone. Each headquarters within the Army had an an outstation manned by Royal Corps of Signals operators and an Army Air Liaison Officer (ALO) - this was a 'tentacle'.

All tentacles with a division were on the same frequency, and each division also maintained a tentacle at Corps headquarters. Thus all command levels could monitor support requests emanating from the front line, and if necessary cut in and object on the grounds of duplication or danger to friendly troops. This also permitted simultaneous reception of RAF tactical reconnaissance reports, and as adjacent army corps were also 'on net' this data along with the details of the close support strikes was immediately circulated throughout the Army.

The sanctioning of airstrikes was intended to be the responsibility of the Army Chief of Staff and RAF Senior Staff Officer, but practice proved that the control centre was capable of handling this responsibility. The procedure was for the joint staff at the control centre to evaluate air support requests as they came in, checking the proposed targets in relation to the 'bomb-line' - a line, projected forward of friendly troops and where possible based on

physical features easily identifiable from the air, beyond which aircraft were permitted to attack targets. If the target was accepted the squadron designated for the task was then contacted via the direct communications to the airfields, where the ALO's attached to the squadrons were alerted to brief the pilots, who were to identify their targets by means of photographic maps with grid references.4 The principal features of the air support system are described below.

Air Support Signals Units.

The tentacles were grouped into special units which were at first called 'Close Support Bomber Control' - reflecting the early (1940/41) assumption that air support would be the responsibility of RAF Bomber Command - and later 'Army Air Support Control'. In 1944 they became the full responsibility of the Royal Corps of Signals and were renamed Air Support Signals Units, or ASSU's. They enabled army formations down to Brigade level to request air support via the combined Army/RAF control centre, and they were standardised to allow their deployment to Corps, Division, or Brigade headquarters. They were also attached to RAF headquarters at Wing and Group Control Centre. Each ASSU tentacle consisted of a vehicle, usually an

armoured half-track, a driver /mechanic, and a crew of three operators to man the powerful wireless (WS Cdn.9) working on the tentacle net and the remote receiver for reception of RAF tactical reconnaissance broadcasts.5

The most important principle regarding the ASSU's was that they remain rigidly independent of the control of the formations to which they were attached. This prevented wireless sets and their operators being misappropriated by 'on the spot' commanders and diverted from their task of relaying air support requests and data. Deployed ASSU's came under the command of the formation to which they were attached, but were under the direct control of the 'G' (Operations) staff and never under the jurisdiction of the Signals staff. Tentacle wireless traffic was likewise delivered direct to the 'G' staff, and never passed through ordinary Signals channels where its priority may have been compromised. The formation to which an ASSU tentacle was attached became responsible for its administration, but technical supervision was exercised by mobile servicing detachments sent by a main ASSU headquarters.6

Forward Control Post.

The British air support system proved very successful in processing pre-planned air support strikes, but the test was really how quickly air support could be provided in response to impromptu requests from the forward troops, where speed was vitally important. In this respect, both in Italy and in the early stages of the campaign in North-West Europe, the process was simply not fast enough. A British Army report on air support in late 1944 identified where the problem lay by observing that,

> *This failure cannot be laid at the door of air support communications, but must be attributed to the number of links in the chain, and particularly to time spent at Army/Group HQ in the discussions which took place between Army and Air Staffs before orders were issued for the engagement of the target.*[7]

The solution was to modify the existing machinery and procedure, though ironically this amounted to another link in the air support chain. The original system had envisaged the provision of Visual Control Posts (VCP's) at the battlefront which, as the name implies, were intended for the visual control of aircraft from a position on the ground commanding a view of the battle area. Experience proved that such ground was rarely found, so the VCP's were modified to become small forward air support controls. They became known as Forward Control Posts (FCP's) and were most

significant in the operational development of the ASSU's as they were intended to decrease the time factor in the provision of immediate close air support.

An FCP was an advanced headquarters, staffed by a senior RAF Controller (often a Wing Commander) and a staff officer from the Army Air Liaison Group, and equipped with ASSU communications enabling them to intercept traffic on the tentacle net and to speak to the tentacles deployed with the forward troops, the RAF/Army Control Centre, and to airborne aircraft by means of VHF. Tentacles with the forward troops could at any time talk direct to the FCP, which could quickly determine the urgency of targets submitted. For a target where speed was not essential the air support system would function in the usual way, with the FCP monitoring but not intervening. However, when it was clear that a target needed to be engaged rapidly the RAF Controller at the FCP could 'step in' and handle the request. In this case the RAF/Army Control Centre was informed by telephone or R/T link that the FCP would deal with that particular target and the requesting army formation contacted by R/T to arrange target details. Strike aircraft, either at airfield readiness or possibly already in or near the battle area were then contacted and briefed in the air. In this way the FCP relieved the main Army/RAF

Control Centre of much of the urgent air support workload.8

Each FCP was designed to fulfil the requirements of one army corps and was normally sited alongside corps headquarters. When FCP's were required to support more than one corps they were sited to the best wireless advantage at the expense of proximity to any particular headquarters - adequate communications making close physical proximity unnecessary.9 The FCP's originated with British forces in Italy, where due to their ability to be switched between headquarters without disrupting normal air support communications they were known as ROVER. FCP's operating in support of British Eighth Army were ROVER PADDY and ROVER DAVID. Each FCP required a sizeable committment of manpower and equipment. In North-West Europe a typical FCP consisted of three 3-ton lorries, an army transmitter vehicle containing the three necessary tentacle sets, an RAF transmitter vehicle and a receiver coach and office.10 When operating in support of Fifth Army in Italy during late 1944 ROVER PADDY consisted of six officers (two senior Army Air Liaison Officers, two Royal Artillery Liaison Officers, and two RAF Air Controllers) and 34 other ranks. Transport consisted of five jeeps with trailers, two 15-cwt trucks, two armoured cars, and two White scout cars - most fitted with W/T, R/T and

VHF communications equipment - in addition to several vehicles equipped with W/T sets specifically for communicating with Air Observation Post (AOP) light spotter aircraft.||

Contact Car.

The FCP's depended upon information sent back from the battle area, but operational experience still proved the need for a means of controlling aircraft at the battlefront, particularly during mobile operations. The solution was further decentralisation of control - the creation of a modified form of tentacle known as the Contact Car. This consisted either of a White scout car or half-track which, in addition to the normal tentacle wireless (WS Cdn.9), was equipped with two VHF sets (TR.1143) for ground/air communication and another wireless set (WS No.22) for the dual purpose of receiving air reconnaissance broadcasts and intercepting the air support control network. Contact Cars were RAF units, and their normal tentacle crew was supplemented by an RAF Wireless Operator/Mechanic whose responsibility was to maintain the VHF equipment. They could function as normal tentacles, but their task was really to enable an RAF Forward Air Controller (FAC) to communicate with aircraft overhead at the battlefront.

Contact Cars were used both to control aircraft obtaining air reconnaissance data for forward troops and to control strike aircraft. In the case of the former task, an RAF reconnaissance pilot was attached to the Contact Car. A request for a reconnaissance sortie was relayed by the Contact Car to the G (Intelligence) (Air Reconnaissance) at Army headquarters who signalled back to the Contact Car the estimated time of arrival of the aircraft. On arrival over the forward area the pilot was briefed by his fellow pilot attached to the Contact Car, to whom he reported the results of his mission. This was then circulated over the tentacle net to be received simultaneously by all formations listening in. For controlling airstrikes the procedure was slightly different in that the FAC attached to the Contact Car was usually an experienced ground attack pilot, often a Squadron Leader or Flight Lieutenant, able to give the pilots a target briefing and to advise them during the attack using the terms that one pilot would use to another.12

During 1944-45 some variations of the Contact Car were developed to meet particular operational requirements. Jeeps equipped with VHF and WS Cdn.9 sets compressed the Contact Car facilities into a small vehicle, and were successfully employed during the crossing of the Rhine in 1945. For the amphibious

assault on Walcheren in November 1944 a Weasel amphibian was fitted out as a tentacle and manned by an ASSU crew. However, in contrast to the Americans, use of contact tanks in offensive operations was never fully developed by British forces. In North-West Europe tanks fitted out as ASSU's were little more than armoured shelters for the controllers to operate their ground/air communications,13 while in Italy contact tanks as employed by US forces were used for the first time by the British as late as March 1945, when modified Shermans with the North Irish Horse successfully directed airstrikes closely coordinated with the assault on the Comacchio Spit.14

Army Air Liaison Officers (ALO's).

The ALO's assigned to RAF units and the joint Army/RAF Control Centre were the chief agents in linking the RAF and Army for close air support operations. This was acknowledged by the RAF, a history of air support in North-West Europe compiled by 2nd TAF observing that the Air Liaison Sections attached to fighter-bomber wings were '..*the focal point of the Wing's operations*'.15 Within 2nd TAF in 1944, the air support system as it affected the ALO's with a fighter-bomber Wing functioned as follows.

Throughout the day and night Situation Reports ('SitReps') were received from the battle area via ASSU and teleprinter, while any special information was received from the joint RAF/Army Control Centre by telephone. This data flow enabled the ALO's constantly to update their situation and bombline maps. Target details were also received by ASSU or telephone from the Control Centre. When the battlefront was static, an overnight list of likely targets for the following day came through by teleprinter, allowing the ALO's to collect briefing material and thus save some time by anticipation.

Executive orders for airstrikes came through RAF channels, and on their receipt the ALO's arranged briefing material (maps and any available photographs) and obtained details as to the estimated time over target from the Wing Commander or flight leader as soon as possible and relayed this immediately to the Control Centre and ASSU's. Pilots were then briefed, it being the ALO's chief responsibility to ensure that pilots were aware of the position of the bombline and that of friendly troops near the target area.16 On the return of the pilots the ALO's took part in their debriefing, and a flash report was sent over the ASSU net containing all information of interest to the Army. Details of the mission were also issued in an RAF operations flash.17

The Flawed System.

There were weaknesses in the British air support system, and a consequent inefficiency that can be seen in several spheres of the air support procedure. One weakness was acknowledged in 2nd TAF's immediate post-war history of air support in North-West Europe. This observed that Contact Cars controlled airstrikes usually as a result of being delegated the task by the FCP controlling that sector, but that the FCP staff did not always delegate despite the obvious advantage of having the airstrike controlled by an observer with the forward troops. This was because,

> *Individual performance by Air Liaison Officers and pilots in contact cars varied considerably, and there was a natural reluctance to authorise local control where the standard of performance did not appear to offer reasonable prospects of successful prosecution.*18

In late 1944 the British Army produced an outspoken report on air support based on the experience gained thus far in North-West Europe.19 This highlighted another, persistent, problem in the system - that of the correct use of codes and cyphers in air support communications. It was acknowledged that this was an extremely confusing aspect of the system and the report noted that,

> *The balance between security and speed has to be struck constantly, and as constantly adjusted in the light of changing operational conditions.*'20

During that campaign the Germans had been able to set up a warning system against air attack based on the interception of support requests from British Army units. When this was realised at RAF/Army staff level it created a security scare with, in the opinion of the Army report, *'..the result that many unnecessary restrictions were recommended.'*21 Investigation proved that the Germans had been able to intercept ASSU traffic not as a result of a failure in the system, but because army formations had been misusing it. It was found that some units were using the immediate support request procedure, when messages could be sent in clear, to request air action as much as 24 hours ahead, while all too often units were relaying bombline details which revealed the intentions of the army units in clear rather than in cypher.22

Insufficient training, failure to properly understand the procedure, or simply carelessness were all likely to have been contributory factors to this, but another may have been that the ASSU's themselves were being worked to the limit. During both static and mobile operations the volume of signals traffic was immense, yet the number of trained ASSU personnel was limited. In 1944 the Army noted that ASSU tentacle NCO's carried far more responsibility than their ordinary Signals equivalents and that their task was far more demanding. It observed that,

*A Corporal operator with a British tentacle does a job similar in many respects to a Canadian Tentacle Officer or a US Major with an Air Support Party.*23

A characteristic of the British system appears to have been the provision of manpower barely adequate to fulfil assigned tasks, and this was seen in the Army Air Liaison Sections. To carry out the tasks related above, an Air Liaison Section attached to an RAF fighter-bomber wing of several squadrons normally consisted of only four ALO's supported by two clerks, the senior officer being a GSO.2 who also acted as military advisor to the RAF Group Captain commanding the Wing and the Wing Commander (Flying) who planned the Wing's operations. Not surprisingly, the Army firmly resisted RAF attempts to have the task of dealing with cypher traffic at tentacles assigned to the Wing added to the already heavy burden of ALO responsibilities.24

More serious incompetence in the system had been exposed during operations by late 1944, namely with regard to air/ground recognition and bombline discipline, both of which were poor.

Air/Ground Recognition.

Correctly identifying friendly troops and vehicles in any terrain from a fighter or fighter-bomber aircraft moving at speed over a battle area obscured by smoke

was no easy task, and a great deal of awareness of the problem and the taking of adequate safety measures by both the Army and RAF were required. In both Italy and North-West Europe (but particularly in the latter) this was often lacking. In Normandy the problem was acute, largely because training in air/ground recognition procedure had been severely handicapped before the invasion by delay in the promulgation of agreed methods. The basic principles and recommendations were worked out after extensive trials in Britain some 18 months before D-Day, but final instructions were not issued until shortly before the invasion. As a result, as the Army later acknowledged,

> *..no issue of apparatus or painting of vehicle signs were possible, and..no worthwhile training between the two Services could take place.*25

Moreover, there had been a dispute within the Army as to whether identification signs should be painted or carried on vehicles at all - one argument being that if Allied pilots could see them, so could German - and the Armoured Corps at first refused to have any such markings applied. Given that the degree of air superiority attained by the Allied air forces could not be forseen before D-Day this argument seems reasonable, but it exacerbated an already confused situation.

Air Attacks on Friendly Troops.

Poor air/ground recognition procedure inevitably resulted in aircraft attacking friendly troops and, particularly in Normandy, there were frequent occasions when British and Canadian troops were attacked in error by their supporting aircraft both during static and mobile operations. Analysis by the Army in 1944 found that the number of such incidents peaked during the transition from semi-static to mobile warfare, when Allied forces were advancing and when bomb lines became very fluid. For the most part the offending aircraft were flying free-ranging armed reconnaissance missions as opposed to being detailed for specific close support strikes, and had obviously either failed to identify correctly columns of friendly troops and vehicles or had misjudged the bomb line - though in such operations ground forces often penetrated beyond the bomb line.26

Both in Italy and North-West Europe Allied troops were supplied with canisters of yellow smoke with which to identify themselves to friendly aircraft, and it is sobering to read of many instances when air attacks were pressed home against friendly troops carrying out the correct recognition drill by releasing such smoke. On August 20th 1944 in Normandy First Canadian Army produced a report listing 52

separate instances of attacks by fighter bombers - Spitfires, Typhoons, Mustangs, and USAAF Lightnings - against its forward troops that had occurred between August 16th-18th and which had killed 72 and wounded 191 officers and men and destroyed or damaged 12 vehicles. Some of these attacks had been made despite yellow smoke being released, and in one case despite an Air Observation Post (AOP) artillery spotter plane attempting to ward off the offending Typhoons. Not surprisingly, First Canadian Army called for all possible steps to be taken to reduce such occurrences, warning that if not,

> *..this powerful weapon in* [support] *of the army will constitute a deterrent to ground* [operations] *rather than the stimulant of which it is potentially capable.*27

This is precisely what happened, the Army report of late 1944 on air support observing that

> *..the moral effect on our own troops is great and out of proportion to the material damage inflicted, and has a hangover which lasts some time, during which, units become cautious and less ready to call for air support.*28

Such attacks, though not on such an alarming scale, persisted and the troops developed an acute awareness of the threat. When Beauvais was liberated its French citizens were perplexed to see the passing British Grenadier Guards anxiously glancing skywards, and one of them asked why, when the Allies had air superiority, the British troops should fear air

attack. According to the Regimental History,

> *The reason was simple. Bitter experience had taught the Battalions that friendly planes, especially in forward areas and during swift advances, were often to be feared more than those of the enemy.*29

Bombline Discipline.

Accurate data regarding the exact location of bomblines was a recurrent problem. Army formations often set bomblines too far ahead of friendly troops. This was erring on the safe side, but had operational disadvantages. One was that many German positions were left within the bombline. Because of an RAF ruling that no target was to be engaged within the bombline unless marked by coloured artillery smoke (a precaution against air attack on friendly troops), these positions could not be attacked by air when smoke was unavailable. Even when smoke was available responsiveness of air support could be reduced, for if a target was to be marked by artillery firing red smoke this alone could sometimes take up to 30 minutes to arrange.30 Another disadvantage was that, as the Army report of late 1944 admitted,

> *..the RAF lost confidence in the bombline as a reasonably reliable indication of the position of forward troops, and were prepared to argue over the position of the bombline in relation to those troops.*31

Such disputes threatened to throw the entire air support machinery out of gear by making nonsense of the basic information relayed by the ASSU's and distributed by the ALO's upon which airstrikes were planned. The result was confusion and, in extreme cases, attacks on friendly troops as related above.

The Uneasy Partnership: Army/RAF Relations.

From a historical perspective it is surprising that there were such problems inherent in the British air support system, for the RAF had successfully provided close support to the Army during World War I. Indeed, in 1917/18 the RFC/RAF pioneered many of the later techniques of tactical air support. British aircraft operated with tanks during the Cambrai offensive of 1917, and by 1918, in contrast to 1943-45, air/tank integration for offensive operations was highly developed. Squadrons were attached to the Tank Corps for the specific purpose of dealing with German anti-tank defences, and a system of rotation was introduced whereby Tank Corps officers were assigned to air duty and aircrew to serve in tanks for familiarisation.32

Experiments in wireless communication between tanks and aircraft were also conducted, largely by the commander of No.8 Squadron, Trafford Leigh-Mallory - later Air Marshal Sir Trafford Leigh-Mallory and

overall commander of the Allied Tactical Air Forces in 1944.33 The utility of a communications centre linking air and ground units was realised, and in August 1918 the RAF established a wireless information centre near the battlefront which, working from air reconnaissance data and reports from the front line, was able to contact airborne aircraft and direct them to ground targets.34

Yet during World War II senior airmen were determined to avoid a commitment to support the Army. This was not only due to concern that such a commitment would lead to the loss of the RAF's independent status, but because close support had come to be recognised as a misuse of air power. In May 1941, after experience of the German use of tactical air power, the War Office demanded that the RAF be prepared and equipped to provide similar support to the British Army, particularly against German tanks. This was bitterly resisted by the Air Ministry, and the Vice Chief of the Air Staff, Air Vice-Marshal Slessor, condemned what he saw as the Army's *'..tendency...to turn round and ask the Air Force to do what it should be doing itself'*, adding that,

> *It is <u>not</u> the job of the Air Force to stop deployed tanks. That is the job of the anti-tank weapon on the ground...The job of the air is to make it impossible for the tank to go on owing to shortage of fuel, food and ammunition...In other words, I do not believe in close support at all except in the very rare occasions when you have to throw in everything to avert a disaster (and that*

*disaster should not threaten if you have used your air properly from the beginning).*35

Moreover, close support was considered likely to be very costly. Group Captain Basil Embry, who had led airstrikes against German troops in France in 1940, warned the Air Ministry in May 1941 that,

*With the scale and intensity of the German A.A. Defence low bombing in close support of land operations is likely to bring about a casualty rate amongst our bombers out of all proportion to the results achieved.*36

It is against the background of RAF hostility to the concept of close support that the British air support system of 1943-45 must be assessed. The air support machinery was set up and manned by two independent services and could only operate smoothly and efficiently as a result of a genuine spirit of cooperation. As a result of the dichotomy which occurred after 1918 neither service had any worthwhile experience of cooperating closely with the other until after 1941-42. By 1943-45 Allied air superiority and the large number of tactical aircraft available made close support possible and a workable machinery was in place. But it was manned by an air force whose high command was fundamentally opposed to the role and an army unused to utilising air support, and whose General Staff was, for the most part, too unfamiliar with air power to fully appreciate its potential, and its drawbacks, when applied to the battlefield. There

was too little RAF/Army commonality, and too much bitterness and recrimination, for the air support machinery to function at its full potential effectiveness.

That this was likely to be a problem in North-West Europe was foreseen, by none other than Field Marshal Montgomery. In North Africa Montgomery had been a firm believer in close Army/RAF relations, and one of his first steps after assuming command of Eighth Army in August 1942 had been to ensure that the Army Headquarters and that of RAF Desert Air Force were located together and that the senior air staff officers shared his mess, a move welcomed by Air Marshal Coningham, commanding Desert Air Force, and Air Marshal Tedder, Air C-in-C Middle East.37 After his return from Italy in January 1944 Montgomery found a very different situation prevailing in the forces preparing for OVERLORD, and on May 4th he expressed his concern in a letter to the Army Commanders who were to serve under him in Normandy:

> *..it has been gradually brought home to me that there is a definite gulf in England between the Armies and their supporting Air Forces..*
>
> *Formation and unit commanders, and the regimental officers and men, must be taught to realise that without the help of the air they cannot win the land battle...*
>
> *I feel very strongly on the whole matter, and I know that we can achieve no real success unless each Army and its accompanying Air Force can weld itself into one entity.*38

Yet by this time both Coningham, who was to command RAF 2nd Tactical Air Force in North-West Europe, and Tedder, Eisenhower's Deputy, were greatly disillusioned with Montgomery. They had resented the prestige and popularity accorded him after Alamein while the air forces had received little recognition; they had also been critical of what they saw as his over cautious pursuit of Axis forces after Alamein and his failure to take sufficient note in his plans of the need to secure airfields - a criticism that would also be levelled at him in Normandy.

Despite his protestations on the need for close Army/Air Force liaison, Montgomery appears to have done little to remedy the situation in early 1944 whereby the various Headquarters were situated far apart; 21st Army Group near Portsmouth, the Air C-in-C at Stanmore, and Coningham at Uxbridge. There was also much RAF resentment that, at this period, Montgomery embarked upon a morale-raising tour of camps and factories, leaving his Chief of Staff, De Guingand, to deal with the senior airmen. In short, there was much ill-feeling on the part of senior airmen towards the Army in general and Montgomery in particular, an unpromising atmosphere in which close air/ground integration could hardly flourish and which would worsen during the campaign.39

There was also much bitterness on the part of the Army, many of whose senior staff in 1944 believed that there was little genuine RAF desire to make air support work, though the Army report of late 1944 on the subject admitted that at the operational level relations were good:

> *..the difficulties are usually greatest at the higher levels, and decrease at the lower end of the scale. At the first point where practical executive action has to be taken, the difficulties begin to disappear, and from there downwards, in nine cases out of ten, there is no problem.*40

One example of the tenuous RAF/Army relationship occurred in Normandy, when the Army felt particularly aggrieved by what was seen as a successful attempt by the RAF to deal the authority and influence of the Air Liaison Sections a damaging blow. As a result of an RAF reorganisation of its command structure, the RAF requested that the rank of the senior ALO in an Air Liaison Section be reduced from GSO.2 to GSO.3 in order to be kept in line with the RAF senior Wing Intelligence Officer. This was reluctantly agreed to, but resulted in the senior ALO being equivalent only to a Flight Lieutenant. Not only did this severely reduce prospects of promotion, a move hardly calculated to attract the best talents to the air support sphere, it was seen by the Army as unjustified. The Army report of late 1944 complained that,

..the work of the senior ALO at a wing of five fighter or fighter bomber [squadrons] carries considerable responsibility, and is of an importance which justifies a second grade appointment.41

This was regarded as one manifestation of RAF hostility to Army involvement in air operations, another Army grievance was the experience of the sections of the 'G' (Operations) staff within British Army formations responsible for coordinating plans for air support. These sections were known as 'G' (Air) and by late 1944 were considered to be functioning effectively, though it was felt that their existence had been resented by the RAF:

..the Air Forces were left with the wrong impression of G (Air) whom they were inclined to regard as pseudo experts in what they considered purely air matters, and as an unwelcome barrier between themselves and the General Staff. This attitude has subsided during the course of operations, but it did not make the task of G (Air) any easier in the early days.42

The Army's principal grievance, however, was that the soldiers had been firmly excluded from any role in decision making as to the weapons and tactics employed in close support. The Army report of 1944 condemned the RAF's,

..apparent disapproval of any attempt on the Army's part to become too familiar with, or too expert in, their business, and their jealous interpretation of the creed that the Army should confine itself to stating the problem, and the Air Forces decide the method, with no crossing of the lines.43

Certainly the Army had had no influence in the type of aircraft employed in close support. After the defeats of 1940/41 the Army demanded aircraft capable of providing the same support as enjoyed by German troops, and in particular dive-bombers. This was successfully resisted by the RAF and Air Ministry, senior airmen such as Slessor pointing out that the omnipotence of the German 'Stuka' dive bomber was illusory and its success due only to German air superiority and the weakness of its opponents' anti-aircraft defences.44 There is a general consensus among historians that the rejection of dive-bombers was the correct course, but at the time this appeared to the Army to be one of many instances of the RAF being unwilling to provide air support, and fuelled demands for a separate Army air arm. 45

The result of this decision was that in 1943-45 none of the aircraft providing close support to British troops had been originally developed for the task, being swing-role fighter-bombers as opposed to dedicated ground attack aircraft, and carrying bombs or rockets in addition to their fixed gun armament. Their effectiveness in this role is discussed in subsequent chapters, but from the Army point of view the fact that they had been designed as interceptor fighters for the defence of Britain meant that they had one major drawback - lack of range. The late 1944

Army report on air support complained, in view of experience in North-West Europe, that,

> *..the available British fighter and fighter-bomber effort has been of short range type, and this characteristic has proved a handicap throughout the operations...it has been found necessary on frequent occasions to employ the longer range US aircraft on the British front to cover vital areas and targets, with all the consequent difficulties of recognition, communications and briefing...When the break out from the bridgehead had been achieved and mobile battle conditions had set in, the RAF ability to support a rapidly moving Army was seriously curtailed by the lack of range of their aircraft, whose bases would go out of action just at a time when air support was most needed to maintain the momentum of the advance..*[46]

The Army also resented a what was perceived to be the lack of RAF interest in developing and improving the techniques of operating with ground forces. The RAF's knowledge of the Army remained *'depressingly low'* with *'..little sign of recognition of the fact, let alone any desire to bring about improvement.'* Only one joint school of instruction in air support had been set up and was in the Army's view unsatisfactory, as

> *..the object of the course has been confined almost entirely to teaching the soldier about the Air Force, a statement which might be qualified by substituting - to teach the Army what the Air Force thinks the Army ought to know about the Air Force.*[47]

This was clearly resentment against what was seen as a patronising RAF attitude towards the Army, but it must also be borne in mind that there was a great lack of comprehension of the entire subject of air support

within the Army itself, which can be seen as the result of the Army having little or no experience of utilising it. As the 1944 report admitted, when the G (Air) staffs were created,

> *..there was an inevitable tendency to treat G (Air) as a new and separate branch of the Staff, and for the General Staff at almost all levels to regard air support as the specialised business of this new branch rather than their own.*48

Many senior General Staff officers, lacking operational experience of air support, either left all air support problems to their G (Air) sections, thereby giving them little direction as to what was needed, or controlled their activites too rigidly, thereby stultifying what expertise they possessed. The 1944 report identified what was needed to correct this situation, and in doing so highlighted a fundamental weakness in the British Army's conception of air support - that most senior officers shared with the senior airmen the tacit assumption that air support was something other than what they should be concerned with:

> *..improvement can only come from a recognition of air action as an integral part of Army operations and from experience and study. If this recognition is to take practical form a reorientation of our training will be necessary so that at all stages and in all staff colleges and schools, supporting air action is taught and studied in the same way and with the same priorities as other operational subjects.*49

The British Army of 1943-45 was doctrinally unprepared for such a step, nor would it have been

tolerated by the RAF. In 1941 the latter Service had successfully resisted Army attempts to subordinate air operations to those on the ground, and had been vindicated in North Africa. But in 1943-45 the RAF still, as Chester Wilmot observed,

> *..suffered from a 'junior service' complex, and was forever eager to assert its right to equality and independence.*50

This attitude emanated from the top, and subordinate RAF tactical air commanders who proved willing to closely co-operate with the soldiers in 1943-45, such as Air Vice-Marshal Broadhurst who had commanded RAF Desert Air Force after Coningham and later 2nd TAF's No.83 Group in North-West Europe, were sometimes censured for this by their seniors.51 By early 1945 there was also a hardening attitude on the part of the Army. Its report of late 1944 condemned the continuing deference to RAF wishes and, with an eye to the future, advocated a firmer stance:

> *..in matters of high policy affecting the two Services the Army has deferred to the Air Force in almost every instance..This may have been a question of policy, and was certainly not unconnected with...the advantages conferred on a Service fully engaged operationally at a time when a large proportion of the Army was inactive. The situation has now changed and the Army has come into its own as a war winning factor, but our approach to joint problems does not seem to have been affected, and the policy of appeasement still governs much of our dealings with the Air Force. Whether a policy of appeasement was ever profitable is a matter of opinion...In any case it is difficult to believe in it under the present circumstances where, superficial affability and goodwill on the one hand,*

*and behind the scenes criticisms and backbiting on the other...constitute a poor substitute for genuine cooperation.*52

II. THE US AIR SUPPORT SYSTEM.

The system of air support employed by the USAAF and Army in North-West Europe and Italy was broadly similar to that of the British. In some respects it was more innovative and flexible, though the same problems that dogged the British system were also evident and appear to have been the result of the same underlying cause - inadequate air/ground cooperation.

The System in Outline.

A US Tactical Air Force consisted of several Tactical Air Commands (TAC's) composed of fighter, fighter-bomber and reconnaissance squadrons and which approximated to an RAF Group. Thus in early 1945 the Ninth Air Force in North-West Europe comprised the IX, XIX, and XXIX Tactical Air Commands. Each TAC supported a particular Army within the Army Group. As far as possible, Tactical Air Force and Army Group, and TAC and Army, headquarters were located together. When this was not possible, the TAC's maintained a small mobile command echelon at the advanced

headquarters of the corresponding Army. Air Force headquarters planned the deployment of the TAC's and medium bomber units, controlled the movement of air units, and prepared long range logistical plans. Air Force headquarters also co-ordinated the planning of large scale air operations involving the operations of more than one TAC.

Each TAC planned and coordinated the day to day air support of its corresponding Army. This planning, including the selection of targets and allocation of air effort, was conducted from a 'Combined Operations Center' at TAC/Army headquarters which was manned by joint Air Force and Army staff. Each evening a briefing, known in the Ninth Air Force as the 'Evening Target Conference', was held during which the day's operations and the programme for the following day were outlined. Normal procedure was for the Army G-2 (Intelligence) to summarise ground operations of the day and the Army G-3 (Operations) to describe those planned for the next day and submit a list of request missions. The Air Intelligence Officer (A-2) would then present new items of air intelligence and the A-2 Target Officer outline potential targets for consideration. A weather report would also be given.

After the briefing the Air Combat Operations Officer (A-3) would announce air units available for operations, first deducting units required for special

targets ordered by the Tactical Air Force Headquarters and those needed for bomber escort. He would then allocate units for armed reconnaissance missions beyond the enemy front line and attacks upon air-designated targets. The balance, less units undergoing maintenance, were allotted to pre-arranged air support missions. This priority accorded to armed reconnaissance was normal during periods when the battlefront was mainly static with few offensive operations by ground forces, a post-war US study observing that,

> *In a stable situation, the major portion of the air effort was allotted to armed reconnaissance and escort..*
> *..Air effort was seldom allotted to close-in missions unless the Ground Forces were attempting an advance at that point.* 53

Orders were then issued assigning tasks to Groups (the equivalent to RAF Wings), which in turn designated squadrons for particular missions. Plans for major air support operations were drafted at TAC level and submitted to the headquarters of the Tactical Air Force where they were finalised by the joint Army and Air staff.54

Air support requests submitted after 2400 hrs for execution on the same day were evaluated by the Army G-3 according to urgency and the importance of the role of the ground unit making the request in the Army plan. The mission was plotted on a constantly updated

situation map and the bomb line checked. This procedure took about 15 minutes, and requests were processed in turn. After checking and approval by the Army G-3, the request was submitted to the Air Combat Operations Officer at an adjacent desk. If it was approved and aircraft were available the A-3 would assign a squadron or group for the task, notifying the group headquarters by telephone or teleprinter. The ground unit making the request was notified of either acceptance or refusal; in the former case the estimated time of arrival of the aircraft was given and in the event of a refusal the reason was stated. Requests for immediate support were also decided upon by the Combat Operations Officer, who could divert aircraft from pre-arranged missions, but mostly such requests, if accepted, were answered by diverting fighter-bombers from armed reconnaissance missions.55

Liaison with ground formations was effected by Tactical Air Party Officers (TAPO's) - also known as Tactical Air Liaison Officers (TALO's) or Air Support Party Officers (ASPO's) depending upon which TAC they represented - pilots whose combat tour had expired and who were attached to the headquarters of Corps, Divisions, and armoured Combat Commands for a period of 90 days in rotation to advise the military commanders on air matters and, in particular, to evaluate the air support targets submitted by the army

G-3 (Air) - the staff officer responsible for air support matters. TAPO's were provided with communications personnel and UHF and VHF radio equipment for relaying the air support requests to the TAC headquarters. The TAPO's also acted as Forward Air Controllers for directing airstrikes, army formations being accorded additional TAPO's for this purpose.56

In Italy the XII TAC adopted the British ROVER FCP system for controlling airstrikes in support of the Fifth Army, assigning the FCP the codename ROVER JOE.57

Army representation with air units was by army staff officers G-3 (Air) and G-2 (Air), the latter responsible for intelligence, being attached to the TAC headquarters. In addition, Ground Liaison Officers (GLO's) were attached to groups and squadrons. Their task was effectively the same as their British ALO counterparts - to keep the air units informed of the situation in the battle area and to maintain the group and squadron battle situation maps. They also played a key role in the pre-mission briefing of aircrew, ensuring that pilots were familiar with the bomb-line, and also took part in their debriefing.58

The Superior System.

In some respects the US system of air support reflected a greater spirit of commonality between air and ground forces than seen between the RAF and British Army, and a consequent mutual willingness to experiment and adopt innovations to improve the system.

This can be seen with regard to the provision for the forward control of aircraft. Although this had been pioneered by the British in the Mediterranean, in North-West Europe they were slow to adopt the Visual Control Post method. Before D-Day it had been outlined in an AEAF memorandum that such control of aircraft was most appropriate as part of a prearranged plan, and would only be employed at the discretion of Air Marshal Coningham. As a result, provision of VCP's was scant, amounting to one per Corps, and the British Army report of late 1944 observed that,

> *The machinery to control a small reconnaissance/striking force over the advancing columns was not included in any of the pre-D Day organisation, and as a result had to be met by improvisation.*59

In contrast, each US Air Support Party could function as a forward VCP, and they were allotted on a scale of one per infantry division, and sometimes two or three per armoured division.

Another US innovation, instituted in Italy, was the use of light artillery observation aircraft (Piper L-5 'Grasshoppers') to direct fighter-bombers to close support targets. By June 1944 the XII TAC was employing L-5 aircraft equipped with SCR-522 radios and flown by fighter-bomber pilots operating as airborne Forward Air Controllers. This innovation was known as 'Horsefly' and the usual practice was for two L-5's to be assigned to each Corps. They were given distinctive markings for pilots to distinguish them from L-5's operating as conventional artillery spotters and, in addition to the FAC, carried an infantry observer for the purpose of identifying friendly troops; operating with US armour they carried an observer trained to distinguish US from German tanks. Usually flying at 3,000-4,000 feet, Horseflys used smoke bombs to mark targets and were of particular value when artillery was unavailable to mark targets. They provided an easily located orbit point for the fighter-bombers, while the L-5 observer could rapidly ascertain the results of the airstrike. Horseflys were also successfully employed beyond the battlefront, sometimes roving up to 20 miles behind German lines to direct fighter-bombers against targets of opportunity.60

The employment of airborne FAC's was not fully adopted by the British despite the necessary machinery

being in place - the Air Observation Post (AOP) artillery observation squadrons manned jointly by the RAF and Army and equipped with Auster light observation aircraft (which had been set up despite strong initial RAF/Air Ministry opposition),[61] Towards the end of the campaign in Italy AOP aircraft were used occasionally, with some effect, to direct RAF fighter-bombers, but were never so employed in North-West Europe. A sense of missed opportunities and unrealised potential lends pathos to a reading of the history of the AOP, which describes how *'by a coincidence'* during the crossing of the Rhine a squadron of Typhoons found itself to be on the same wireless net as the British artillery below and their attached AOP flight:

> *Some completely unofficial briefings were given to the Typhoon Flight Commanders whose pilots destroyed a Tiger tank only 300 yards ahead of our troops, after an Air O.P. pilot had pointed it out by R/T.*[62]

However, although the XII TAC took the Horsefly system to Western Europe after the invasion of Southern France and employed it successfully, it never found favour with other US forces in that theatre - this being one of several indications that Allied forces in Italy showed more enterprise in the control and application of air support than their counterparts in North-West Europe.

The American system also provided a solution, which originated with XII TAC in Italy, to the problem of German positions being left within the bomb line. In Italy the latter was usually fixed between 5 and 10 miles ahead of friendly ground forces, and never closer than a distance estimated as 10 minutes away by infantry advance from the front line. This permitted significant German forces to operate in an area immune from air attack and, in order to prevent this, an additional line known as the 'close cooperation line' was introduced. This was designated immediately in front of friendly troops by the G-3 (Air) at Corps headquarters, who based his positional details on data received from the forward troops. As their positions changed the necessary map references were sent to the senior air controller at Corps whose task was to ensure that airstrikes did not occur within the close cooperation line but remained between the latter and the bombline. This demanded constant updates as to the position of the close cooperation line, which were passed on to the AAF Wings and Groups by the senior air controller at Corps, while the Army G-3 (Air) had the responsibility of informing Army headquarters. Conducting airstrikes close to friendly troops demanded the utmost efficiency in the flow and processing of data from the front line, for it was found that during intensive operations the position of

the close cooperation line could change up to ten times in a day.63

The US air support system was also more flexible in the utilization of radar. The British Army report on air support of late 1944 lamented the fact that 2nd TAF had not been able to make use of the SCR-584 precision radar, demonstrated before D-Day, for the navigational guidance of aircraft and for 'blind bombing' in close support whereas it had been successfully employed by the US Ninth Air Force throughout the campaign.64 British use of radar was mainly defensive, and it was not employed for 'blind bombing' until 1945. In the US system each TAC had a Tactical Control Center (TCC) sited near the Combined Operations Center. This was a radar control group centred upon a Microwave Early Warning radar (MEW) which was situated 10-30 miles from the battlefront. The MEW was supported by Forward Director Posts (usually three) and three or four SCR-584 Close Control Units. Originally designed for air defence, this network was extensively employed to guide strike aircraft responding to close support requests to the target area, and sometimes to the target itself, with great precision, and proved of particular value during periods of adverse weather.65

The most significant example of the flexibility of the US air support system compared to that of the

British was the close integration of air and armour in order to provide continuous air support during mobile operations. This was effected by assigning flights of fighter-bombers to cooperate closely with spearhead armoured units at each stage of an advance, controlled by a FAC riding in a VHF equipped tank. This was known as 'Armored Column Cover' and was introduced by IX TAC (of Ninth Air Force) for the breakout from Normandy. Armored Column Cover is examined in Chapter IV.

The System Qualified.

For the most part the advantages of the US system were innovations made as a result of operational experience. Yet that same operational experience also revealed serious weaknesses.

One was that, as in the British system, insufficient manning 'levels at times threatened efficiency. In North-West Europe, during September/October 1944, a staff officer (G-3) of US 12th Army Group was detailed to conduct an investigation into the efficiency of the air support system and in that period visited seven corps and thirteen divisions of the US First, Third, and Ninth Armies and their supporting TAC's. His investigation revealed considerable variations in available manpower at Army level. The First Army's G-3 Section consisted of four officers, that of the Ninth

Army seven, while the Third Army Section had nine. This meant that while the G-3s (Air) of the Seventh and Ninth Armies were able to spend considerable time at Army headquarters and be involved in the planning of operations, that of the First Army was compelled to be almost constantly at the TAC combined operations room and was consequently less familiar with the overall operational plan. In Ninth Army it was found that a minimum of 5 officers was essential to handle the routine functions of a G-3 section in a 24-hour period, while the four extra officers made possible visits to GLO sections, consultation with higher and lower echelons, and the filling of unexpected vacancies in the G-3 or GLO sections.66

At corps level manning was adequate, but at divisional level there were problems. Armoured divisions in the US Army had been recently reorganised, with some still functioning under the old table of organisation. These had full time G-3 (Air) officers in addition to a normal G-3 but, surprisingly given the extent to which close air support was employed, divisions with the new organisation had no such allotment, the normal G-3 having to act as a G-3 (Air) in addition to his regular duties. A similar situation prevailed in the infantry divisions, and for the most part the soldiers were of the opinion that this was detrimental,

pointing out that a full time G-3 (Air) had the opportunity to become thoroughly familiar with air support technique and procedure as well as relieving an already under-staffed G-3 section of a considerable workload.67

Considerable differences in air support procedure existed among Army formations, and the relative amount of responsibility assumed by the G-3 (Air) sections and the Air Support Party Officers (ASPO's) varied widely. This meant that some G-3 (Air) sections and ASPO's were very much in touch with the air operations taking place in their sector of the battlefront, while others could hardly have been less so. The 1944 investigation described how,

> *Some corps ASPOs virtually run a miniature forward fighter control and supervise the employment of all aircraft operating in the corps area. At the other extreme, one corps does not use its VHF radios except in connection with some special operation.*68

To a great extent this came back to the question of manpower, it being found that in most infantry divisions the lack of a full time G-3 (Air) necessitated the ASPO engaging in staff work to the detriment of operational duties.69

Inadequate staffing and a lack of uniform procedure threatened to produce inefficiency and poor performance, and there were frequent examples of this. One was that Army divisions complained that they were not receiving sufficient notification of the number of

aircraft allotted to them and their 'time over target' during pre-planned close support operations.

This was a serious problem, threatening the fundamental utility of air support, for without timely notification of these details the army were not well placed to exploit the air support, and air support if not exploited on the ground was wasted. This was really due to inefficient use of the communications network, but the problem reduced army confidence in pre-planned air support - the 1944 investigation observing that,

> *Divisions point out...that it is extremely difficult to integrate air attacks into the following day's operations unless a division is notified prior to midnight what air support it is to get. This is one of the principal reasons for the virtually unanimous preference of ground force units for support by armed reconnaissance flights which check in with the ASPO and can be used instantly as the situation demands.*70

Similarly, Army units complained of an excessive time lapse in notifying them that air support had been denied or cancelled; the elapsed time varied from four to six hours, and in one instance a unit was told that its air support was cancelled nine hours after the original request.71

As in British experience, many of the problems in the system were the result of poor performance on the part of individuals. There is evidence to suggest that the US Army was less than satisfied with the efficiency of the GLO's attached to AAF units. In a

post-war USAAF study of air support operations in North-West Europe which invited ground force comments, the VI Corps noted that,

> *..it has sometimes happened that ground officers with air units have not kept these units properly informed as to the significance of ground operations as pertains to their currently assigned mission,*

while the XII Corps considered the GLO's,

> *..too cut off, from the ground picture, to be of any real aid to the fighter-group, insofar as giving them any reasonably accurate picture as to present location, and plans and intentions of the ground troops with which they are working.*

The 2nd Armored Division staff suggested that it was the GLO's themselves, rather than the system, which was at fault and pointed out that,

> *Too many GLO's lack combat experience, are not well grounded in the activities of various branches of the service, and lack initiative in that they do not make contacts with the combat divisions to keep abreast of tactical demands.72*

Such blanket criticism of the GLO's may not have been justified. The 1944 investigation highlighted the problem that the army machinery for disseminating information from the battlefront was itself too slow and did not keep up with the pace of battle, and that,

> *GLO sections do not have the latest information on the ground situation because, in spite of the efforts of the army G-3 air section, the situation often has changed by the time army has received and disseminated the information. GLO personnel feel that G-3s air of divisions and corps should be encouraged to send ground information direct to them whenever feasible.73*

Yet some individuals lacking aptitude or commitment undoubtedly constituted 'weak links' in the US air

support chain. Less than two weeks after D-Day three of the four US Corps Commanders in Normandy had sacked their G-3 (Air), despite there being a shortage of suitably qualified officers to take their place. The best replacements, it was found, proved to be officers drawn from the GLO sections attached to IX TAC airfields.74

As with the British system, experience proved that the air support machinery was often not fast enough to respond adequately to calls for immediate support. In all US divisions the ASPO, whose party was equipped with SCR-522 and SCR-399 VHF radios, submitted air support requests to the G-3 (Air) section at Army headquarters. 'Request missions', those required on the same day but not immediately needed, and 'planned missions', those to be flown on subsequent days, were sent through the G-3 (Air) at Corps to the G-3 (Air) at Army. 'Immediate requests', when air support was required as soon as possible, could be sent direct using the SCR-399. However, as the 1944 investigation discovered,

> *..communication to army over the SCR 399 is not satisfactory where time is a factor, because of the slowness of the coding and processing procedures. Even in emergencies when transmission in the clear is authorized, divisions often find it more practicable to call corps and have the request forwarded by teletype.75*

The solution proved to be regular armed reconnaissance flights, either requested by divisions

or allotted without request, 'checking in' with the divisional ASPO's for possible close support targets before proceeding with their armed reconnaissance mission. That it was necessary to bypass the air support machinery reveals the inability of the latter to solve the problem of responsiveness, yet the procedure of employing armed reconnaissance patrols worked. It resulted in a sharp reduction in the number of immediate support requests and was, according to the 1944 investigation,

> *.the outstanding contribution of the campaign to effective close air support.*[76]

Attacks on Friendly Troops & Operational Problems.

A serious problem, shared with the British, was the propensity of tactical aircraft to attack friendly troops. Air/ground recognition procedure was often poor, and General Bradley describes an incident in Sicily when a flight of A-36 dive bombers persisted in attacking a column of US tanks that were releasing their yellow smoke recognition signal. In self defence the tanks fired on the aircraft, hitting one and compelling the pilot to bale out. On his landing the soldiers realised that they had been wasting their time releasing the smoke for the pilot had had no idea what it was.[77] On another occasion in Sicily A-36's bombed the headquarters of British XXX Corps,

mistaking it for a German strongpoint they were to bomb in close support of US troops attacking near Troina.78

Such occurrences persisted both in Italy and North-West Europe. Richard Hallion refers to 'one particularly nasty' incident in Italy when strafing P.40 fighter-bombers inflicted over 100 friendly casualties during the advance on Rome.79 The problem was acute during the early stages in Normandy, and between June 8th-17th 1944 aircraft of IX TAC attacked US troops on nine separate occasions.80 Predictably, ground units became wary of air support and troops soon began to fire at anything in the air. This was bad enough, but the problem worsened when troops, in order to avert friendly attack, displayed their coloured air recognition panels when they were not in front line positions. Pilots may or may not have been given adequate briefing as to where the bombline was, but it was inevitable that in many cases pilots seeing such panels displayed assumed that troops seen ahead of these positions were enemy, - one US First Army report noted that a pilot had seen panels all the way back to a corps headquarters.81

There was also some concern regarding the execution of close support strikes. In Italy in October 1944 an outspoken memorandum compiled by XXII TAC revealed several problems in operating the ROVER system, most

likely when fighter squadrons unused to close support work were being employed. Flights were often late in engaging their targets and on many occasions flight leaders did not know their assigned mission number and even lacked maps of the target area. Some had not been given alternative targets before take-off and their tactics were inadequate, with bombing runs too shallow and there obviously being no plan of attack. Radio discipline was also poor, with much unnecessary 'chatter' clogging the Rover channels.82

Many of these problems resulted from inadequate air support training of both ground and air forces. For example, the US air and ground forces that fought in Normandy had had little opportunity to train together in England before D-Day. The Ninth Air Force was committed to supporting operations of the Eighth (strategic) Air Force until a very late stage and when, in May 1944, it became available for such training it was too late - the ground forces had been sealed into their pre-embarkation marshalling areas and were no longer available for exercises. Few large-scale regimental or divisional exercises involving aircraft had taken place, thus troops were unused to working with aircraft while the fighter-bomber pilots remained unfamiliar with working with troops and largely untrained in dive-bombing and strafing battlefield targets.83

Very little priority and too little thought had been given to close air support, and this was seen not only in the major weaknesses of the system but also in the comparatively minor problems - but which could have far reaching effects. Communications equipment caused problems. The standard VHF radio, the SCR 522, originally developed for aircraft, proved unreliable and unable to stand the rigours of ground force use. It was eventually replaced by the sturdier SCR 624, but radios of the period were vulnerable to overheating, dust, and vibration, while spare parts were very difficult to obtain.84

A further problem was that confusion resulted in corps and divisions during air support missions as a result of the channels on ground and aircraft VHF radio sets being lettered differently. Yet another was that both GLO's and ASPO's in 1944 reported difficulty in obtaining adequate equipment from their parent formations to enable them to function properly, in particular tables, maps, and acetate. It was also discovered during the 1944 investigation in North-West Europe that the number of VHF radios allotted to divisions varied considerably and affected efficiency. One armoured division had as many as fourteen, enabling it to furnish one to each infantry and armoured battalion, while another had only two, permitting one to each of its two Combat Commands but

allowing for no Air Support Party (ASP) at division headquarters.85

US Army/USAAF Relations.

As with that of the British, the US air support system must be judged in the light of existing Army/Air relations. In World War II the USAAF was no more committed to the principle of close air support than the RAF. During the 1930's and throughout World War II the AAF leadership pressed for the maximum possible autonomy within the War Department as a step towards eventual independent status for the Air Force.86 The AAF Tactical School in the pre-war period favoured the strategic bombardment theory, and by 1935 regarded the gaining of air superiority as the single most important air mission. Tactical operations were not favoured, though it was acknowledged that after gaining air superiority pursuit (fighter) aircraft might be employed to isolate the ground battle area by attacking enemy supplies and reinforcements. However, the idea of air units being in any way subordinate to ground forces, or under the control of a ground commander, was firmly resisted. Even the installation of bomb racks on new fighter aircraft was prohibited between 1936 and 1938, and as late as 1941 the Plans Division of the Air Corps remained opposed to any

modification of such aircraft for ground support work.87

There were also very few aircraft available specifically for close support. Like their counterparts in the RAF, and for the same reasons, senior airmen rejected US Army calls for the adoption of dive bombers after the outbreak of war in Europe. This decision was sound, but the fact remains that in 1941 the USAAF possessed no doctrine and no aircraft for co-operation with ground forces.88 By May 1943, after experience in the North African theatre since November 1942, the former situation was changed when The War Department published Field Manual 100-20, *Command and Employment of Air Power.*

Attempts to distribute air assets and subordinate them to ground force operations proved unsatisfactory in North Africa, and this gave the AAF the opportunity to declare its independence from such control. FM 100-20 declared air power a co-equal and independent force, the command of which was to be centralized in the hands of a senior air commander responsible only to the overall theatre commander. Mission types were clearly prioritized. First was the need to secure air superiority, while second priority was accorded to attacks on enemy troop concentrations, supplies and communications outside of the battle area. Close air

support was accorded third priority, but was clearly frowned upon, FM 100-20 warning that,

> *..in the zone of contact, missions against hostile units are most difficult to control, are most expensive, and in general least effective...Only at critical times are contact missions profitable.*89

Thus the close air support system of 1943-45 was manned by an air force whose senior command felt little commitment to the role. Indeed in 1945 the very term 'support' was declared to be objectionable within Ninth Air Force, and the term 'cooperation' substituted.90

This is not to suggest that there were serious problems in the Army/Air relationship at the operational level. In fact there was a greater degree of commonality than in the British system, at least partly due to the fact that the USAAF and Army were separate arms of the same service. One feature of this, seen in both Italy and North-West Europe, was an extensive programme of exchanging air and ground personnel for short periods of time: In the Ninth Air Force alone thousands of air and ground officers, and enlisted men, were attached to parallel ground and air units for familiarisation. The intention was for pilots to see ground combat at first hand and for army personnel to participate in air operations. According to a post war analysis of the Ninth Air Force this policy brought dividends:

*Air crews developed a keener sense of their responsibility and the capabilities of their weapons in combined air-ground warfare and ground forces personnel learned first-hand the extent, power and limitations of the air effort. The entire program improved morale in both services and increased good will and understanding.*91

In Italy in 1944 the 42nd Bomb Wing, whose medium bombers provided close support during the fighting at Anzio, thereafter instituted an exchange programme and subsequently reported that,

> *There is a great difference in the mental attitude of aerial crews when "close-in" Army targets are attacked as opposed to the normal strategical target. Crews will fly through intense flak to a "close-in" target and do an excellent piece of work. Ten days later the same crews will fly into just as intense flak to attack a bridge or supply dump and do only a fair job.*92

Such familiarisation was necessary, as much for the soldiers as the airmen. Ground force commanders often failed to appreciate that air support, to be effective, had to be an integral part of an operation rather than simply appended to it. The 1944 investigation of air support in North-West Europe noted that,

> *Some air personnel feel that maximum effectiveness of air support sometimes is not obtained because of the commander's failure to call in G-3 air until after a plan has been adopted, rather than during the planning stage.*93

CONCLUSION

Given the opposition of both the RAF and USAAF to the principle of close air support it is remarkable that the British and US air support systems were broadly successful in welding together air and ground forces and integrating air and ground operations. This was largely due to a determination to make air support work on the part of some of the more junior air commanders, such as Air Marshal Broadhurst of No.83 Group of 2nd TAF and Major-General Quesada of IX TAC, both of whom were willing to cooperate with the soldiers.

Yet the Allies were also fortunate in 1943-45 in that their air forces had already achieved air superiority over the Luftwaffe, and had an abundance of aircraft available for close support work. Thus the weaknesses in the system could easily be masked by quantitative superiority. The highly critical British Army report of late 1944 on air support observed that it was necessary,

> *..to guard against confusion between quantity and quality and any tendency to allow overwhelming weight to slur over weaknesses in technique and performance which otherwise would be self evident.*[94]

And this warning is as valid for the historian now as it was for the soldiers and airmen then.

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CHAPTER III.

THE FIGHTER-BOMBER WEAPON 1943-45.

Introduction.

In Europe in 1943-45 most close air support for Allied troops was provided by fighter-bombers, fighter aircraft which, in addition to their fixed gun armament, were fitted with bombs or rockets for engaging ground targets. Consequently the following chapters are primarily concerned with operations carried out by these aircraft, and the purpose of this chapter is to provide a preliminary discussion of the fighter-bomber weapon.

I. FIGHTER BOMBING.

The Germans were the first in World War II to employ their fighter aircraft as bombers. In the late summer of 1940, after excessive losses had compelled the withdrawal of medium and dive-bomber units from daylight operations over Britain, Bf.109E fighters were equipped to carry bombs. By the autumn each

fighter group had formed a fighter-bomber squadron (*Jabo Staffel*) equipped with Bf.109E-4/B aircraft capable of carrying either one 551-lb or four 110-lb bombs.| These were employed on 'hit and run' raids across the Channel which caused only limited damage but which were extremely difficult to counter, No.11 Group RAF eventually resorting to the provision of standing patrols to guard against them.2 While this employment may be seen as 'strategic', the Bf.109E-4/B's were later used in the Balkan, Mediterranean, and Russian theatres in the close support role. Tactics were fairly crude, the usual method of attack being a 45° dive with the bomb being aimed by means of the standard Revi reflector gunsight.3

After the RAF/Air Ministry rejection of dive-bombers no dedicated ground attack aircraft were employed operationally by the RAF in Europe or the Middle East and in early 1941 no fighter aircraft were equipped to carry bombs.4 However, the desirability of providing fighter aircraft with a measure of striking power against ground targets was acknowledged and feasibility tests conducted with the Hurricane IIA, later versions of which were equipped with underwing attachments for external fuel tanks which could also house 250-lb general purpose (GP) bombs. Meanwhile in North Africa, during the successful First Libyan Campaign against Italian forces in December 1940-

January 1941, machine-gun ground strafing attacks had already been carried out, Hurricane pilots being ordered to use their remaining ammunition against any likely ground target when returning from patrols.5

In the UK later in 1941 the Hurricane marks IIA and IIB appeared, the former fitted with twelve .303in machine guns and the latter with four 20mm cannon. These were now designed as bomb carriers with strengthened wing attachments, the IIC being employed by Nos.1 and 3 Squadrons on low altitude intruder missions ('Rhubarbs') across the Channel. By the autumn two squadrons equipped with the IIB were conducting cross-Channel fighter-bombing raids using tactics developed during the summer by the Air Fighting Development Unit. The RAF's first fighter-bombing attack in Europe was carried out on October 30th 1941 when No.607 Squadron bombed a transformer at Tingry. Other targets included airfields and enemy occupied buildings. These were usually attacked in a low level approach by pairs of Hurricanes releasing their bombs and pulling up at the last moment, allowing the bombs to continue towards the target. As such attacks increased so did German anti-aircraft (flak) defences, necessitating a change of tactics and a recourse to dive-bombing. Targets were then attacked from slightly different directions at once, in order

to split the flak concentrations, in a 65/70° dive with bombs released between 12,000 and 5,000 feet.6

By this time thought had also been given to the use of fighter-bombing and strafing attacks in support of troops, with senior Army officers quite enthusiastic. In late 1941 General Sir Alan Brooke, Chief of the Imperial General Staff, was greatly impressed by an RAF demonstration of cannon-equipped fighters attacking lorried infantry and guns, and noted in his diary that,

> *There is no doubt that the single-seater multiple machine-gun fighter is destined to play a serious part in ground attacks.7*

In November 1941 the first RAF fighter-bombers became operational in North Africa, No.80 Squadron with obsolescent Hurricane Is fitted with eight underwing 40-lb fragmentation bombs. They made bombing and strafing attacks upon Axis mechanised transport columns and tank concentrations in support of Operation CRUSADER, with strafing proving more effective, but their losses to flak were prohibitive. On November 27th the squadron ceased strafing attacks, and by mid January 1942 had reverted to the fighter role on re-equipment with Hurricane IICs.8

They were superseded in the fighter-bomber role by a series of US built Curtiss P-40 aircraft, known in the RAF as Kittyhawks, which combined a bombload of up to three 500-lb bombs and the firepower of six .50in

machine guns. In May 1942 No.112 Squadron became the first of many operational Kittybombers to see service with RAF Desert Air Force in North Africa and later in Sicily and Italy.9 At this stage fighter-bombers were not employed in close support, and when not attacking lines of communication often reverted to fighter duties. The first significant use of fighter-bombers in a close support role in North Africa occurred on March 26th 1943 in Tunisia, when eighteen Allied squadrons attacking in waves directly ahead of advancing New Zealand troops successfully silenced German gun positions in the Tebaga Gap.10

There was little opportunity to employ fighter-bombers in close support in Western Europe at this time, but on August 19th 1942, in support of the raid on Dieppe (Operation JUBILEE), Hurricanes of No.174 Squadron carried out fighter-bombing attacks while those of Nos.3 and 43 Squadrons strafed German positions. In the face of effective flak defences the cost was high, No.174 Squadron alone losing 5 aircraft.11

In 1943 the RAF moved to what was to become its close support workhorse in North West Europe and its most successful fighter-bomber of the war. Hawker Typhoon fighters, designed as high speed interceptors, became operational in the UK in 1942. Their rate of climb and high level performance proved disappointing

in this role and, initially, a premature operational debut resulted in the aircraft being dogged by an unreliable engine and an alarming tendency for the tail section to fall off in flight.12 However, the aircraft had a robustness ideal for fighter-bombing and in 1943 was cleared to carry two 500-lb, and later two 1,000-lb, bombs. Many Typhoon squadrons converted to fighter-bombers after the first German V-1 sites were discovered in the Pas de Calais in the Autumn of 1943, and for some months were directed against them. In view of German flak this was quite hazardous, but a 2nd TAF study later observed that it provided,

> *..very fine training in map reading and pin pointing small targets, and in the technique of dive bombing so that when the time came for real tactical work with the Army the squadrons were already experienced in work of a very similar nature.*13

It was also in 1943 that Typhoons were fitted to carry the 3-inch rocket projectile (RP).14

The Mediterranean theatre had by then seen the first employment of Spitfire fighter-bombers (in Tunisia); various marks of Spitfire thereafter served in this role with RAF Desert Air Force until the end of the campaign in Italy, and also in North West Europe with 2nd TAF.15

The USAAF followed the British in rejecting the dive-bomber in March 1943, when a conference held at Wright Field to decide upon fighter-bombers or dive-bombers for air support of ground forces chose the

former on the grounds that their fighter characteristics enabled them to protect themselves against hostile fighter action.16 Only one dive-bomber type was employed operationally by the USAAF in Europe, the North American A-36A Invader which equipped two USAAF Groups in the Mediterranean theatre between July 1943 and mid 1944. This aircraft derived from the North American P-51A Mustang fighter and was essentially that aircraft fitted with dive brakes. Most aviation historians agree that these brakes proved unsatisfactory and that they were usually wired shut on operations, the Invaders actually functioning as fighter-bombers.17 As in the RAF, responsibility for close support and much other ground attack duty fell primarily upon the fighter types of the USAAF, all of which had fighter-bomber derivatives.

The first operational USAAF fighter-bomber squadrons were those equipped with Curtiss P-40 single-seat, single engined fighters which arrived in North Africa in late 1942. While as a fighter the P-40 was never an equal match for the German Bf.109, it had already proven its value as a fighter-bomber in service with the RAF and Commonwealth air forces, who styled it the Kittyhawk. To the USAAF it was the Warhawk, and these aircraft, and the later improved P-40M (Kittyhawk III) and P-40N (Kittyhawk IV) variants, became the principal USAAF fighter-bomber in the Mediterranean

theatre until replaced by the P-47 Thunderbolt in 1944. Like their RAF counterparts, the USAAF Warhawks usually carried three 500-lb bombs or occasionally one 1,000-lb bomb in addition to their fixed armament of six 0.50 calibre machine guns.[18] By September 1943 there were no less than thirteen USAAF squadrons equipped with Warhawks serving in the Mediterranean.[19]

The first USAAF Republic P-47 Thunderbolt squadrons arrived in the UK in late 1942, and by the end of 1943 those of the Eighth Air Force returning from bomber escort missions at low level had begun strafing targets of opportunity with their remaining ammunition. Their success led to the adoption of the P-47 as a fighter-bomber.[20] The Thunderbolt was the largest and heaviest single-engined single-seat fighter of World War II, but it was capable of a maximum speed of 433 mph and, unlike the P-40, proved a highly successful air combat dogfighter.[21]

Yet, of all the Allied fighter types pressed into service as fighter-bombers, the Thunderbolt was one of the most suited to the role. Its phenomenally rugged construction and air-cooled radial engine enabled it to absorb considerable punishment from ground fire, while it possessed the formidable firepower of eight wing-mounted 0.50 calibre machine guns and the ability to carry up to three 500-lb, or two 1,000-lb bombs, or up to 10 underwing rockets.[22] By June 1944 the Ninth

Air Force, preparing to support the US armies during OVERLORD, possessed twelve groups of P-47s, each of three squadrons, in its IX and XIX Tactical Air Commands.23 In Italy, USAAF fighter-bomber squadrons began to exchange their Warhawks for Thunderbolts in late 1943, there eventually being nine squadrons equipped with Thunderbolts serving in Italy with the Desert Air Force and XXII Tactical Air Command by May 1945.24

Another USAAF fighter type that saw service as a fighter-bomber in the Mediterranean and North-West Europe was the Lockheed P-38 Lightning, a single-seat, twin-engined and twin-boomed fighter originally intended as a high altitude interceptor. The first to see action were P-38Fs which equipped some USAAF squadrons sent to North Africa in November 1942, and they took a heavy toll of the German air transports ferrying supplies to Rommel's forces from Italy.25 An important attribute of the P-38 was its range, and Lightnings were the first USAAF fighters to accompany bombers from UK bases to Berlin.26 They were effective in the air combat role, though in German skies they proved to lack the necessary manoeuvrability to tackle on equal terms the German Focke-Wulf 190 fighters and the later types of Bf.109 except at the highest altitudes.27

Lightnings began fighter-bombing in late 1943, the P-38 variants then operational being able to carry either two 500-lb, two 1,000-lb or two 1,600-lb bombs or a battery of ten rockets. Their armament of one 20mm cannon and four 0.50 calibre machine guns concentrated in the nose made them potent ground strafers, and both in Italy and North-West Europe German troops came to fear *Der Gabelschwanz Teufel* (the fork-tailed Devil), not least because its comparatively low engine noise gave little warning of its approach.28 In June 1944 the Ninth Air Force possessed nine squadrons of P-38 fighter-bombers (all were in IX TAC), but in both Italy and North West Europe by early 1945 the Lightnings had been almost entirely replaced in the ground attack role by single-engined P-47s or P-51s.29

The North American P-51 Mustang is widely considered the best US single-seat, single-engine fighter of World War II. It possessed the range, with drop tanks, to escort bombers from UK bases all the way to Berlin and the ability to outfight the German Bf.109s and Fw.190s.30 The aircraft was a remarkably successful combination of an American airframe with the British Merlin engine, and the first Merlin-engined P-51B and C Mustangs joined the Eighth Air Force in the UK in December 1943, followed in 1944 by the P-51D with an even more powerful Merlin engine. In early 1944 P-51B

and Cs entered service with the US 15th (Strategic) Air Force in Italy, and also with the RAF who styled these variants Mustang IIIs. A limited number of P-51Ds were also supplied to the RAF as Mustang IVs. 31

In March 1944 Mustang IIIs entered service with the RAF Desert Air Force in Italy as fighter-bombers, and by June 1944 there were also two wings (six squadrons) of Mustang IIIs in RAF Second Tactical Air Force, and a similar number in the US Ninth Air Force.32 As a fighter-bomber the Mustang was able to carry either two 500-lb or two 1,000-lb bombs or ten rockets in addition to its six 0.50 calibre machine guns, but it lacked the robustness of the Thunderbolt for ground attack. Hence, the Mustang was regarded as primarily a long-range escort fighter by both the USAAF and RAF. In the USAAF it was the Thunderbolt that became the ground attack workhorse, while in September 1944 the Mustangs of RAF Second Tactical Air Force were withdrawn from fighter-bombing in order to provide the escorts for Bomber Command's return to a daylight offensive.33

II. FIGHTER-BOMBER CHARACTERISTICS.

Versatility & Flexibility.

The fighter-bomber was a versatile weapon, able to accomplish a wide range of tasks. Both in North-West Europe and Italy these included, in addition to close support, short and long range fighter sweeps, deep and shallow interdiction missions, escort for light/medium bombers, and anti-shipping strikes. In the ground attack role the fighter-bomber also possessed a tactical versatilty denied the dive-bomber, that of being able to deliver bombs and rockets in high-speed low-level passes, which could give a measure of protection from anti-aircraft fire, as well as in steep dive attacks.

Flexibility was also an important characteristic. Fighter-bomber squadrons were not limited to the attack of particular targets, and it was not uncommon for a squadron to carry out, for example, an interdiction mission and follow this with a close air support strike. They could also adapt to last-minute changes of target due to developments in the battle area with a minimum of re-briefing, sometimes by radio while in flight, and they could respond rapidly to target data supplied by tactical reconnaissance

(Tac/R) flights. This can be contrasted with light/medium bombers, which were unable to adapt to rapid changes of target due to the length of time needed to re-brief the large number of aircrew and to prepare aircraft and bomb loads.34

The critical drawback with fighter-bombers, affecting both versatility and flexibility, was combat radius. Table I shows this for the US fighter types employed in North-West Europe:

TABLE I. COMBAT RADIUS OF US FIGHTERS (NORTH-WEST EUROPE). (35)

TYPE	BOMB LOAD	INTERNAL FUEL CAPACITY (gal.)	EXTERNAL FUEL CAPACITY (gal.)	COMBAT RADIUS (MILES) (at 10,000 ft.)
P-38L				
Lightning	None	410	None	290
--------	None	410	330 (2 tanks)	600
	2 x 500lb	410	None	260
	2 x 1000lb	410	None	250
P-47D				
Thunderbolt	None	370	None	280
----------	None	370	188 (1 tank)	400
	2 x 500lb	370	None	260
	2 x 1000lb	370	None	230
P-51B/C/D				
Mustang	None	269	None	350
--------	None	269	216 (2 tanks)	750
	2 x 500lb	269	None	325

Table I reveals the difference between the potential long-range fighter and the fighter-bomber, in that carrying bombs and/or rockets considerably reduced combat radius. This table is based on the experience of the US Ninth Air Force in North-West Europe, but Table II is based on an ORS study of Desert Air Force

operations in Italy during early 1945 and indicates an even greater limitation. Maximum combat radius with ordnance load is given, taking into account the need for the aircraft to return to base on internal fuel after an operation and loiter time in the target area:

TABLE II. FIGHTER-BOMBER COMBAT RADIUS, ITALY 1945. (36)

TYPE	BOMB LOAD	COMBAT RADIUS IN MILES
Spitfire VIII	1 x 500lb (occasionally 2 x 500lb)	130
Spitfire IX	1 x 500lb (occasionally 2 x 500lb)	95
P-51B/C	2 x 1000lb	200
Mustang	2 x 500lb	250
Kittyhawk IV (US P-40N)	2 x 500lb	140
P-47 Thunderbolt	2 x 500lb plus rockets	165
	2 x 1000lb	165
	2 x 110 gal, Napalm fire bombs	165

Particularly apparent is the limitation of the British Spitfire compared to the US fighter types. As shown in Chapter II, lack of range was a major British Army criticism of the tactical aircraft with which the RAF provided air support. The Spitfires of Desert Air Force were largely restricted to immediate battle area missions as their range precluded anything else.37 The Typhoon could do better, with a maximum range of 510 miles with bombs, but in terms of combat radius this

would have been effectively halved.38 With regard to close support, the necessity of airfields not too far removed from the battlefront is obvious for all the above Allied types.

Also apparent from Table II is the low ordnance load of the Spitfires, those with Desert Air Force rarely carrying more than one bomb. By late 1944 those serving with 2nd TAF were carrying a 1,000-lb bomb load (typically one 500-lb centreline and a 250-lb under each wing) but this was really beyond their capability, it being found that 60% of all accidents were caused by burst tyres due to the excessive weight.39 Here again the Typhoon did better, its sturdier construction enabling it to carry up to 2000-lb of bombs or eight underwing rockets.40

Firepower & Economy of Effort.

As the above tables show, Allied fighter-bombers possessed impressive firepower. In Italy during 1944 the Operations Staff of RAF Desert Air Force outlined the firepower and economy of effort of fighter-bombers in comparison with the other aircraft type employed against ground targets (though, in comparison with fighter-bombers, infrequently in the close support role) - light/medium bombers. This was by reference to the Load/Personnel Factor, whereby the load is

expressed as weight of bombs dropped by a Squadron in one day of intensive operations, and the personnel the number of aircrew and groundcrew required to make this effort possible. The results, shown in Table III, indicate how fighter-bombers compared favourably regarding the number of missions that could be flown, the weight of bombs that could be delivered, and the number of personnel required.

TABLE III. LOAD/PERSONNEL FACTOR.

FIGHTER-BOMBERS.

Kittyhawk (at 1,500lbs per aircraft) at 3 squadron missions per day = 54,000lbs
Total Personnel Required = 243. L/P Factor: 222

Mustang (at 2,000lbs per aircraft) at 3 squadron missions per day = 72,000lbs
Total Personnel Required = 243. L/P Factor: 297

LIGHT/MEDIUM BOMBERS.

Baltimore (at 1,500lbs per aircraft) at 2 squadron missions per day = 35,000lbs
Total Personnel Required = 349. L/P Factor: 104

Marauder (at 4,000lbs per aircraft) at 2 squadron missions per day = 96,000lbs
Total Personnel Required = 521. L/P Factor: 184

This question was also investigated by ORS Mediterranean Allied Air Forces, and Table IV shows their breakdown of the manpower backing required for the aircraft types employed by Desert Air Force.41

TABLE IV. MANPOWER PER SQUADRON, DESERT AIR FORCE, NOVEMBER 1944

AIRCRAFT TYPE	AIRCREW (OFFICERS & NCOs)	GROUND OFFICERS	GROUND PERSONNEL	TOTAL
Kittyhawk) Mustang) Spitfire)	30	6	208	244
Mosquito) Beaufighter)	48	7	334	389
Marauder	156	13	336	505
Baltimore	132	7	249	388
Boston	118	5	256	379

Against most targets, fighter-bombers offered a more profitable return in terms of damage inflicted for effort expended. Although fighter-bombers had their problems with regard to accuracy (see below), they were nevertheless able to tackle most targets with more precision. For example, in the same report Desert Air Force observed that,

> *The ability to strike a bridge with medium altitude bombers is extremely difficult to achieve in view of the narrow target it presents and recent experience has shown that one Squadron of Kittyhawks can succeed where large formations of medium bombers have failed.*42

Moreover, fighter-bombers did not present such good targets to heavy flak batteries as formations of mediums bombing in daylight, the chief threat to fighter-bombers being light automatic flak (see below and Chapter VIII). Only targets that requiring pattern, or area, bombing, such as extensive defended positions or gun areas, were more suited to attack by light/medium bombers.

Ease of Maintenance & Handling.

Fighter-bomber squadrons required little more maintenance than those of fighters. A larger armament staff was needed for the fusing and maintenance of bombs, but bomb racks, fusing and release mechanisms needed only routine maintenance from squadron armourers. Moreover, fighter-bombers could be handled and taxied much easier and faster than light/medium bombers, particularly on rapidly constructed forward airstrips with narrow taxiways and dispersals. It was mainly this which enabled fighter-bomber squadrons to carry out three, and sometimes more, missions per day as opposed to the usual two of light/medium bomber squadrons.43

Fighter-Bomber Organisation.

In 1944 RAF fighter-bomber units were organised into Wings comprising a headquarters and between three and six squadrons. In late 1944 two of the three Typhoon wings serving in No.84 Group of RAF 2nd TAF each had four squadrons while the third comprised three. The same situation prevailed in No.83 Group.44 In Italy at this time, No.239 (Fighter-Bomber) Wing consisted of six squadrons. According to Desert Air Force this

enabled,

> *..the wing to maintain intensive operations as a whole or if split into two for any reason.*

However, maintaining such a large strike force under the administrative and operational control of a single headquarters brought problems. The DAF study observed that,

> *The chief disadvantage (and a big one, on occasions) is accomodation* (sic) *both for aircraft and personnel...a considerable amount of ground is required to accomodate* (sic) *approximately 96 aircraft and 1600 personnel.*45

In fact there was a serious problem of airfield congestion in Italy in the winter of 1944-45 which adversely affected fighter-bomber operations, particularly at Fano, where six British and three US squadrons were based, and Forli from where six British squadrons operated. The usual airfield procedure was for aircraft to take off and land in both directions, in order to bring aircraft as close to their dispersals as possible and minimise the distance over which they had to taxi.

Usually a single taxi strip would be used for two squadrons, over which there was an alternating flow of aircraft to and from the main runway. It normally took some 6 minutes for each flight to leave dispersal, taxi to the runway, and take off. The problem in 1944-45 was that the taxi strips were too narrow, and in winter (and spring) aircraft were confined to them due

to mud. The taxi strips were thus packed, delaying take off times, while squadrons returning from operations often had to orbit for up to 40 minutes before they could land. This obviously affected air support timings, as aircraft could not take off on schedule nor arrive in the battle area when expected, and it was estimated that pre-arranged support missions were delayed by at least one hour. Moreover, as an airfield was expected to handle between 200-220 sorties in a ten hour day, it was estimated that this congestion reduced the number of missions flown by 20 per cent.46

Command of a fighter-bomber wing was exercised by a Wing Commander (often holding the RAF rank of Group Captain) who was responsible for the wing's administrative and operational efficiency. The running of the Wing Operations Room and flying operations were the responsibility of his second in command, the Wing Commander (Flying). There was also a Squadron Leader attached to assist in administration duties and an Intelligence Officer, usually a Flight Lieutenant, responsible for obtaining and disseminating all information regarding enemy movements, positions, tactics, and the location of flak positions in the battle area and for maintaining a stock of maps. Operations Officers, usually three with the rank of Flying Officer or Flight Lieutenant, manned the Wing

Operations Room on a 24 hour basis. Their task was to maintain details of squadron states (serviceability of aircraft and states of readiness) and to take details of impending operations and to warn the squadrons concerned. They also briefed pilots and, in wings whose squadrons were frequently employed in close support, worked closely with the attached Army Air Liaison Officers. The total personnel strength of a wing headquaters was about 140, organised as in Diagram I.47

DIAGRAM I. RAF FIGHTER-BOMBER WING HEADQUARTERS.

Wing Commander
(Administrative side)

(Operational side)

Squadron Leader (Administrative)

Wing Commander (Flying)

Wing Headquarters (Signals, Medical, Store, Cyphers & Motor Transport Sections)

Wing Operations Room
3 Operations Officers (1 Flying Control)
Intelligence Officer & Clerk
Army Air Liaison Officers & Clerk

Squadron Headquarters

Squadrons

A fighter-bomber squadron consisted of a headquarters and two flights of aircraft with approximately 12 pilots to each flight. A squadron could be expected to keep 12 aircraft available for operations with 4 more as an immediate reserve, though

during operations the number of aircraft and pilots available varied considerably from day to day. Operations of squadron strength were usually carried out by a maximum of 12 aircraft, an RAF study observing that,

> *..experience has shown that this number makes an efficient and manoeuvreable formation. Anything larger would be unwieldly.*48

Apart from the pilots, most of the other squadron personnel were responsible for servicing aircraft and loading weapons and ammunition, total personnel amounting to approximately 240. The organisation of a typical squadron headquarters is shown in Diagram II.

DIAGRAM II. RAF FIGHTER-BOMBER SQUADRON HEADQUARTERS.

Squadron Commander

(Administrative side) ——— (Operational side)

Squadron Adjutant

Squadron Headquarters
Medical, Stores & Orderly Room
Motor Transport Sections

Administration of two flights

Squadron Operations Room
Intelligence Officer & Clerk

Operation of two flights

Command was exercised by a Squadron Leader responsible for both the administrative and

operational running of his squadron, though his duties were primarily leading his pilots and keeping them up to the mark in tactics and operational efficiency. He would have had a senior Flight Commander as second in command, usually a Flight Lieutenant, whose duties were predominantly flying, the burden of administrative work falling upon the Squadron Adjutant who was generally also a Flight Lieutenant. Each squadron also had an Intelligence Officer, usually with the rank of Flying Officer, responsible for running the squadron's own operations room and for taking details of operations from Wing and for briefing pilots. His primary duty was the debriefing of pilots on their return from operations and the compiling of operations reports to be forwarded to the Wing Intelligence Officer. In squadrons engaged in close support he worked closely with the attached Army ALOs in maintaining maps of the battle area and updating bombline data.[49]

As in the RAF, the basic operational unit of the USAAF was the squadron. However, US fighter-bomber squadrons had an authorised establishment of 25 aircraft plus five in reserve, and a personnel establishment of some 57 officers and 245 men; both varied considerably during operations. Squadrons were organised into Groups of, usually, three squadrons (the equivalent of RAF Wings) and the number of

personnel in a Group was some 200 officers and 800 enlisted men.50

III. FIGHTER-BOMBER TACTICS.

Close support missions were usually carried out by the RAF with flights of between 6 and 8 aircraft, whereas the USAAF favoured the four-plane flight as the basic fighter-bomber unit.51 Larger formations of Wing (RAF) and Group (USAAF) strength, involving a number of squadrons, were employed to attack particularly formidable or important targets, especially in support of major ground operations. Infantry and gun positions, strongpoints, tanks, and defended buildings were engaged either in dive or low-level attacks depending upon weather and visibility conditions, and the amount of flak in the target area. For attacks to be effective, visibility had to be at least 2,000 yards and the cloud base no lower than 5,000 feet for bombing or 3,000 for strafing. During bombing or rocket-firing a strong wind would dictate the direction of approach, often preventing pilots from taking advantage of such factors as the position of the sun and of friendly troops, and could also adversely affect accuracy.52

The chief danger confronting fighter-bomber pilots in 1943-45 was not the Luftwaffe, which was rarely seen over the battlefront in daylight, but German anti-aircraft firepower - flak - the presence and variations of which determined tactics both during the flight to the target and the attack. Ground attack pilots often had to contend with formidable concentrations of small calibre flak that was very effective up to 3,000 feet and the fire of which was not visible to them; therefore they were briefed to come below 3,000 feet only when carrying out their attacks. Heavy calibre automatic flak (20mm-40mm) was effective up to 6,000 feet and its explosions easily seen by pilots; fighter-bomber formations usually flew at 7½-8,000 feet which was just out of its range, yet where the heavier non-automatic flak (such as 88mm) tended to be inaccurate.[53] The effective range of German guns, and particularly that of automatic flak, was often the subject of controversy between pilots and their Intelligence Officers. Bill Colgan, who served as a fighter-bomber pilot with the US 79th Group in Italy, remembers that,

..if pilots were told the 'effective range' of certain of the guns was 5000 feet, and then saw rounds from those guns at 9000 feet or so, many of them said to hell with whether they are 'scientifically effective' up here; more important was the simple fact that they could shoot this high. Other pilots discounted the entire business of studying facts and figures on flak guns, their theory being that where we flew much of the time, a kid could throw a rock and reach us.[54]

As fighter-bomber pilots were primarily trained as day fighter pilots, they flew fighter formations. RAF formations flew in sections of four aircraft flying nearly line abreast, with 50-75 yards between aircraft, and with each section of four stepped up or down 500-1,000 feet depending on the position of the sun.[55] In a 16-plane USAAF squadron the four flights flew in two sections, one flying 300 yards behind the other and from 500 to 1,000 feet higher. In a 12-plane USAAF squadron the flights usually flew in a loose, shallow V, with 200-300 yards between them.[56]

Dive bombing attacks were made by both British and US fighter-bombers at steep angles, usually between 45° and 60°, with the pilots following their leader into the attack and releasing their bombs between 2-3,000 feet. With single-engined aircraft, as the RAF discovered particularly with the Typhoon, it was very difficult for the pilot to see straight down to the ground without tipping up the wing. In Typhoon squadrons the usual procedure was for the pilot flying as the leader's No.2 to be briefed to fly a little further away in order to enable the leader to tip his wing when over the target so that he could judge the exact moment at which to roll over for the dive. Correctly identifying targets was crucial but rarely easy, and it was common for the leader to give a quick final briefing to his pilots by R/T, such as *'The*

target is the white building with the red roof just North of the river bank'. Sometimes extraordinary measures were taken by troops to indicate targets for their supporting aircraft - in Italy in April 1945 No.87 (Spitfire) Squadron reported a dive-bombing attack on seven German tanks laagered near Felice which were *'..indicated by a worthy wearing a white shirt standing 200 paces to the E. of their position.'*[57]

When satisfied that the target was correctly identified, the leader would warn his pilots when he was about to dive by announcing *'Bomb switches on'* followed by *'Going down in 10 seconds'* and *'Going down now'*. A 2nd TAF report on tactics stated that a steep dive was essential for accuracy, and that,

> *..it was best not to roll over into the dive too fast, but to run up to the target in a gentle dive and then pull up gradually, thus losing speed before finally rolling over; otherwise too much speed was gained early on in the dive and sufficient time was not given to line up the aircraft and take off skid.*[58]

Diagram III shows an example of a dive bombing attack as carried out by bomb carrying Typhoons or Spitfires against a lightly defended target from 12,000-7,000 feet or below. In such an attack, when in the target area, the fighter-bombers would have changed from their approach formation into echelon starboard. When over the target, the leader would have allowed it to pass under the leading edge of his port

DIAGRAM III

1st Phase.

TARGET

APPROACH

Direction of Approach ↑

2nd Phase.

TARGET

ECHELON STARBOARD

Direction ↑

3rd Phase (Attack)

Direction of Attack ↓

LINE ASTERN

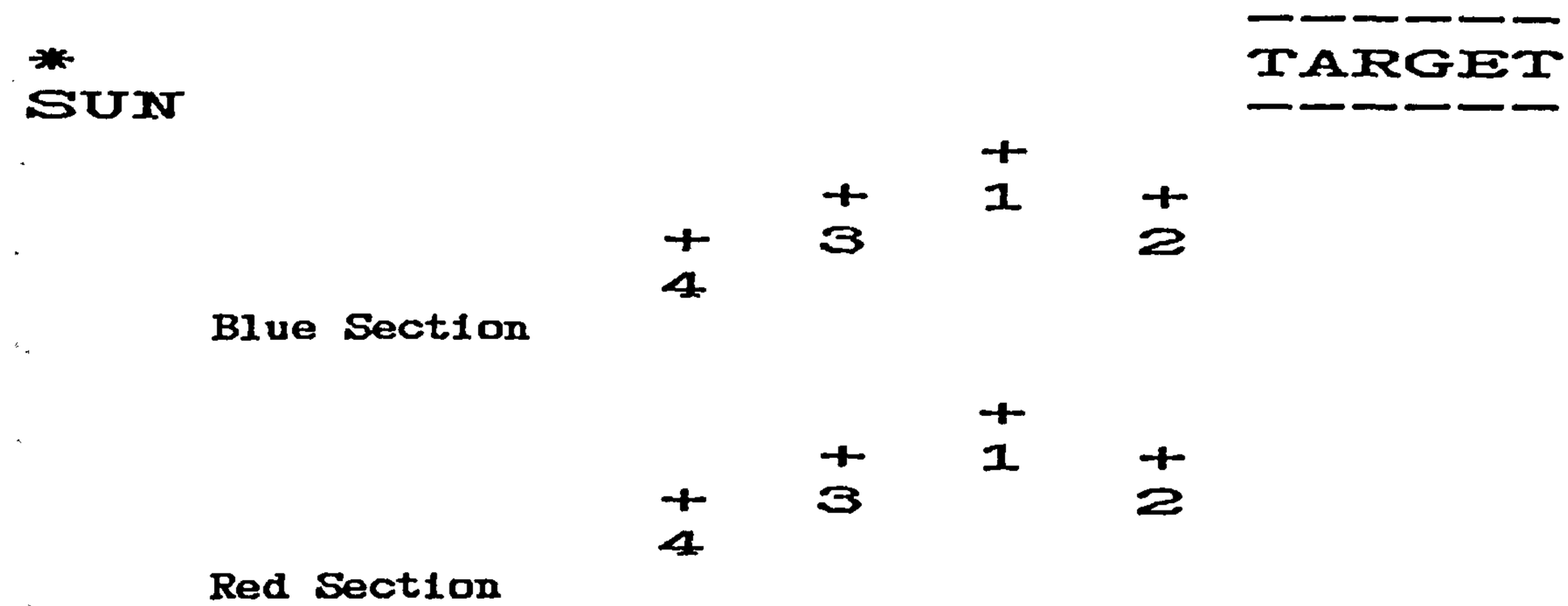
wing as shown in Phase 2 of the diagram. As the target reappeared at the trailing edge, the leader would have executed a semi-stalled turn to port, followed by the others of the section. This allowed for a line astern attack at a steep angle on the reciprocal of the original course, as shown in Phase 3. After releasing bombs, all aircraft would have made a violent evasive turn in a pre-arranged direction before reforming in line abreast. Diagram IV shows a heavier scale of attack from 12,000-7,000 feet by two sections against a heavily defended target. In this case an attempt would have been made to reduce flak effectiveness by attacking from out of the sun and from two directions in order to split concentrations of flak fire.59

Low level attacks were usually carried out in a dive of about 30° with the bombs released at about 800 feet and the aircraft flying at high speed in order to escape small calibre and light flak and the burst and debris from their own bombs. Typhoons usually attacked in pairs, using bombs fitted with short delay fuses so that each pair attacked just after the previous pair's bombs had exploded. However, such tactics could be hazardous against targets heavily defended by flak, and an RAF report warned that in such circumstances,

> *..four aircraft going down in two pairs was all that could reasonably get away with this type of attack.*60

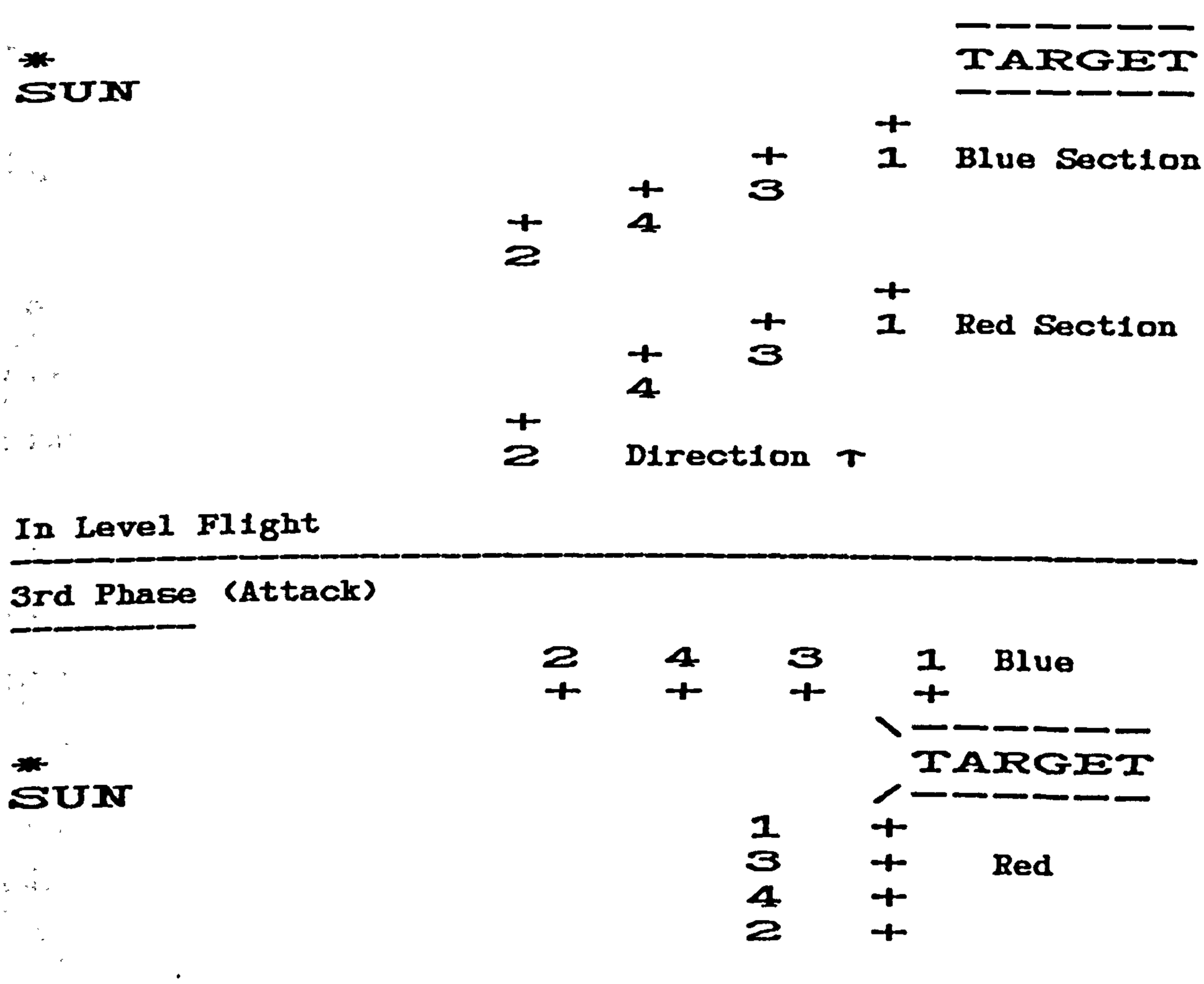
DIAGRAM IV.

1st Phase.



In Level Flight, 12,000 Feet

2nd Phase



In Level Flight

3rd Phase (Attack)

Against targets such as strongpoints in buildings or headquarters, mixed tactics of low level and dive bombing attacks were employed. The usual procedure was to commence with low level bombing against the most prominent buildings, followed by dive bombing immediately the low level aircraft were clear. The RAF found that rocket-firing aircraft, which could also attack either in steep dives or at low level, were particularly successful when employed in such mixed attacks due to the incendiary effect of their rockets.61

Fitting Typhoons with underwing rails, enabling each aircraft to carry eight 3-inch rockets, each with a 60-lb high-explosive warhead, gave them tremendous firepower. The rockets also had several advantages, as described by a former New Zealand Typhoon pilot:

> *Since they were self-propelled their velocity on impact was much greater. Also, a rocket motor created no recoil as it left its carrier, and its warhead could therefore be many times heavier and of greater calibre than any orthodox shell that could possibly be fired from an airborne cannon.*62

The rocket was crude in its simplicity, consisting of a cast iron pipe with a 3-inch diameter motor and with the 60-lb warhead screwed on the front. Four cruciform stabilising fins were attached to the rear and the rocket was connected by lugs to the Typhoon's launching rails. On firing the rocket left the

aircraft with a velocity of about 150 feet per second, its cordite propellant burning for 1½ seconds during which time the rocket could accelerate to over 1,000 feet per second over a distance of 500 yards, thereafter gradually slowing over the next 500 yards as it approached its target.63

As with bombing, rocket-firing tactics were determined by weather and by the amount of flak. Against heavily defended targets pilots were usually instructed to make a steep 60° dive from between 7-8,000 feet and fire all eight rockets in a salvo at about 4,000 feet at a range of some 1,700 yards. If the target was lightly defended, pilots were encouraged to make a shallow dive of 20° or 30° from between 3-4,000 feet and to fire their rockets by 'rippling' them in pairs from 1,500 feet at a range of about 1,000 yards.64 However, such procedures were often disregarded on operations and squadrons soon evolved their own tactics, as a former Typhoon pilot recalls:

*The common practice was to fly down on the deck, or in a shallow dive; aim at 600 or 700 yards, then let go at close range, sometimes 250 yards, with cannon and rockets together.*65

If a target was heavily protected by flak, only one attack could be attempted. Another former Typhoon pilot recalls of such targets that,

..we were always briefed never to attack twice. If you did have to attack twice, then do it from a different direction..because if you started to circle with six

*to eight aircraft, they could wait for you and pick you off as you came back.*66

US fighter-bombers were also equipped with air-to-ground rockets both in Italy and in North-West Europe. In the latter theatre the first P-47 Thunderbolts equipped with rockets became operational in July 1944. They lacked the firepower of the Typhoons, each aircraft carrying only four 5-inch HVAR (High Velocity Aircraft Rocket) projectiles.67 This was later increased, P-47s being fitted with rails for up to ten rockets, but in fact US fighter-bombers in Europe never employed rockets on a large scale. Those of Ninth Air Force fired only 13,959 during the war as opposed to the 222,515 fired by fighter-bombers of RAF 2nd TAF.68 In Italy during late 1944 some P-47s were fitted with underwing infantry-type bazooka tubes to house 4.5-inch rockets (a cluster of three under each wing). These missiles, equivalent to a 105mm howitzer shell, proved extremely effective in attacks on buildings, but the rocket was not a popular fighter-bomber weapon in this theatre even with the RAF. The only RAF fighter-bombers of Desert Air Force equipped with rockets in 1945 were the Mustangs of No.260 Squadron, but each aircraft carried only four 3-inch rockets, two under each wing on special rails enabling one rocket to be housed underneath the other.69

Napalm fire-bombs, often auxiliary fuel tanks filled with petroleum jelly and fitted with a fused igniter, were extensively used by US fighter-bombers in both campaigns. Their delivery demanded special tactics, the object being to tumble the napalm tanks onto the target. In hilly terrain the tanks were usually delivered in shallow dives, while against targets on fairly flat terrain they were dropped in level flight from minimum altitude - creating long swathes of fire that edged towards and engulfed the target area.70

While fighter-bomber pilots frequently fired their machine-gun and/or cannon armament during bombing or rocket-firing, they were also called upon to carry out specific 'strafing' attacks. These too demanded appropriate tactics, and speed and co-ordination were essential as the aircraft were coming down to low level where they were perilously vulnerable to flak. RAF fighter-bombers usually approached their target from a wide turn and with a loss of height that ensured they were at average speed and not higher than 1,500 feet when levelling out for the attack. After steadying their aircraft and getting the target in the sights, pilots would open fire at a height of 700 feet at a range of about 500 yards and at an angle of 25°-30°.71

The guns of fighter aircraft were harmonized for the rounds to converge at a point ahead of the aircraft.

This was an air-to-air combat consideration and in 1943-45, for both the RAF and USAAF, the distance was some 250 yards. At this range the rounds fired would impact the target together, and when pilots were strafing individual targets, such as tanks or vehicles along a road, this was desirable. Low-level strafing of such targets, however, could be perilous for fighter-bomber pilots. Apart from the risk of flak, a slight misjudgement or target-fixation on the part of the pilot could send the fighter-bomber hurtling into the target or into nearby trees and obstructions. Should the pilot have selected a lorry or railway waggon as his target which proved to be carrying ammunition or explosives, this could literally blow up in the pilot's face, hurling debris such as slabs of roadway, lorry or waggon parts, or unexploded ammunition, into the path of his aircraft. Strafing area targets was less hazardous, for then close-in firing was a disadvantage and pilots opened fire at wider ranges in order to cover the target area.72

IV. FIGHTER-BOMBER ACCURACY.

The free-fall bombs and air-to-ground rockets of 1943-45 were highly inaccurate and barely adequate for use against precision targets. This was suspected at the time, and eventually proven in a series of Army and RAF ORS investigations.

Rocket Accuracy.

The British 3-inch rocket was very difficult to place accurately, and delivering it with a fair chance of hitting its target demanded considerable skill. Due to their weight, and how it was distributed, the rockets had a curved trajectory which meant that they needed to be fired within a range of 1-2,000 yards - beyond that range the trajectory curve was so severe as to make accurate firing almost impossible. The relatively low launching speed also meant that if the aircraft skidded slightly or turned at the moment of release a considerable error could result.

Typhoon pilots of 2nd TAF were given initially a three-week course in rocket-firing, followed by regular refresher periods at Armament Practice camps in the UK. During attendance at the latter it was found that pilots consistently tended to undershoot

the target either as a result of releasing the rockets at too long a range or through flying too slowly at the lower dive angles. In particular pilots had to learn to calculate accurately the effect of wind before firing, it being discovered that, for example, a 10 mph wind could result in a 5 yard shift in line and a 3 yard shift in range at the Mean Point of Impact (MPI) - which could easily mean the difference between a hit and a near miss if the target was relatively small, such as a tank or single gun position.73

Pilot accuracy showed significant improvement after a session at Armament Camp, but could never compensate adequately for the weapon's inherent inaccuracy or the lack of an effective sight through which to aim the rockets. The modified Mk.IID gyroscopic sight, which allowed for the initial gravity drop of the rockets as well as for the effect of wind and movement of the target, was not available until late 1944.74 Average Typhoon pilots in trials, firing all eight rockets in a salvo, had roughly a 4 per-cent chance of hitting a target the size of a German tank.75 On operations, with targets camouflaged and difficult to identify, and with pilots under anti-aircraft fire, accuracy could be even further reduced.

In 1945 a joint British Army/RAF ORS study of the effectiveness of rocket-firing Typhoons in the close

air support role, outlined the scale of Typhoon attack necessary to obtain hits on typical targets. This was based on operational data and is shown in Table V:

TABLE V. TYPHOON SCALE OF EFFORT NECESSARY AGAINST TYPICAL TARGETS. (76)

TARGET	SIZE	HORIZONTAL PROJECTED AREA (45° DIVE)	% SHOTS HITTING TARGET	FOR 50% CHANCE OF HIT	
				ROCKETS NEEDED	SORTIES
Small gun position	5 yards diameter	19 square yards	.2	350	44
Panther tank	22' 6" x 10' 9" x 9' 10"	50 square yards	.5	140	18
Large gun position	10 yards diameter	80 square yards	.8	88	11
Army hut	60' x 30' x 20'	270 square yards	2.8	24	3
Large building	120' x 54' x 50'	1000 square yards	10.0	7	1

Very apparent is the high number of sorties and rockets considered necessary to secure a reasonable chance of hitting such relatively small targets as tanks and gun positions. Yet these were, as the report indicated, characteristic of many close support targets.

The advent of the improved sight made some difference. In 1945 ORS 2nd TAF compared the accuracy of rocket-Typhoon attacks against two German-occupied Churches during the fighting at Orloo and Venray in

Holland in October 1944 with eight attacks against defended buildings in Germany during March 1945. The results of the comparison are shown in Table VI. This shows that accuracy still left much to be desired, but also that the later attacks in Germany during the spring of 1945 were more accurate than those in Holland:

TABLE VI. ROCKET-TYPHOON ACCURACY. (77)

	AVERAGE RADIAL ERROR ABOUT TARGET	AVERAGE RADIAL ERROR ABOUT MEAN POINT OF IMPACT	DISTANCE OF MEAN POINT OF IMPACT FROM AIMING POINT
Venray Church tower	111 yards	97.5 yards	64 yards
Orloo Church tower	99 yards	73 yards	62.5 yards
Buildings (March-April 1945)	81 yards	75 yards	43 yards

Bombing Accuracy.

Despite their inaccuracy, rockets could be placed with more precision than free-fall bombs. Table VII shows the number of instances during attacks by Spitfires and Typhoons upon gun positions and strongpoints in 1945 where rockets and bombs actually landed within 150 yards of their target. The targets were all field positions and were attacked at the request of British troops during mobile operations in Germany. The

results reflect the difficulty of landing a bomb on or near a pinpoint target.78

TABLE VII. BOMBING AND ROCKET ACCURACY.

	ROCKETS	BOMBS
NUMBER OF ATTACKS	37	11
NUMBER OF CASES WHERE SHOT WITHIN 150 YARDS	33 (89%)	5 (45%)

Also in 1945 ORS 2nd TAF examined the accuracy of Typhoon bombers in operations between October 1944 and April 1945, nine pinpoint bombing targets were analysed by plotting bomb distributions from air reconnaissance photographs and by ground examination. The results are shown in Table VIII. The average radial error for these attacks was 158 yards, with only 50 per-cent of the bombs falling within 130 yards of the target. For the same investigation seventeen railway line targets were examined, for which a total

TABLE VIII. BOMBING ACCURACY.

TARGET	No. OF BOMBS PLOTTED	AVERAGE RADIAL ERROR (YARDS)
1) Road/rail crossing	10	145 yds
2) Road/rail crossing	30	125 yds
3) Road/rail crossing	24	185 yds
4) Road/rail crossing	13	198 yds
5) Road/rail crossing	31	120 yds
6) Road bridge over river	20	160 yds
7) Road bridge over river	39	190 yds
8) Building	14	124 yds
9) Building	15	178 yds

of 320 bombs dropped by Typhoons and Spitfires were plotted. It was found that the average line error was 69 yards, with only 50% of the bombs falling within fifty yards either side of the target.79 At least targets such as bridges and road/rail crossings could be seen by pilots, whereas many of the close support targets, being small and camouflaged, could not - the pilots being able to aim only at the coloured smoke fired by friendly artillery to indicate the target.

Strafing Accuracy.

The most accurate weapons possessed by fighter-bombers were their cannon and machine gun armament. This was illustrated by the British Army's Operational Research Group in 1945, when they compared 20mm aircraft cannon with the 3-inch rocket and outlined the number of rounds that could be fired per attack per aircraft against ground targets and the probable number of hits secured:

TABLE IX. STRAFING ACCURACY.

WEAPON	ROUNDS PER ATTACK PER AIRCRAFT	HITS ON 10 FEET SQUARE NORMAL TO LINE OF FLIGHT PER ATTACK PER AIRCRAFT
20mm Cannon	120	32
3-inch Rocket	8	0.045

This suggests that the greater number of rounds fired by machine-guns and/or cannon ensured that some were likely to strike the target.80 However, the question remained whether such rounds were powerful enough to inflict serious damage or destruction, and this problem is discussed in the following chapters.

V. THE FIGHTER-BOMBER COMPONENT.

By 1944-45 fighter-bombers were, for the most part, the largest component in the Allied Tactical Air Forces operational in Italy and North-West Europe. This is shown in Table X. Squadrons designated as day fighter have been bracketed with those of fighter-bombers because operational roles were not always clearly defined but depended upon circumstances.81

TABLE X. FIGHTER & FIGHTER-BOMBER COMPONENT OF THE ALLIED TACTICAL AIR FORCES

ITALY		
RAF DESERT AIR FORCE (1945)	**NUMBER OF SQUADRONS**	
Fighter/Fighter-Bombers:	22 (52,3%)	including 3 US P-47 Squadrons attached
Light/Medium Bombers:	7 (16,6%)	
Night Bombers & Night Fighters:	6 (14,2%)	
Air Observation Post:	5 (11,9%)	
Reconnaissance:	2 (4,7%)	
US XII AIR SUPPORT COMMAND (JANUARY 1944)		
Fighter/Fighter-Bombers:	23 (57,5%)	
Fighter/Dive-Bombers (A36A):	6 (15%)	
Light/Medium Bombers:	4 (10%)	
Night Fighters:	3 (7,5%)	
Reconnaissance:	3 (7,5%)	
Radio Counter Measures :	1 (2,5%)	
NORTH-WEST EUROPE		
RAF 2nd TACTICAL AIR FORCE (1945)		
Fighter/Fighter-Bombers:	49 (61,2%)	
Light/Medium Bombers:	13 (16,2%)	
Reconnaissance:	9 (11,2%)	
Air Observation Post:	9 (11,2%)	
US 9th AIR FORCE (1945)		
Fighter/Fighter-Bombers:	45 (42,8%)	
Light/Medium Bombers:	45 (42,8%)	
Night Fighter:	2 (1,9%)	
Reconnaissance:	13 (12,3%)	
US 1st TACTICAL AIR FORCE (1945)		
Fighter/Fighter-Bombers:	24 (50%)	
Light/Medium Bombers:	14 (29,1%)	
Reconnaissance:	8 (16,6%)	
Night Fighter:	2 (4,1%)	

Day fighters frequently flew armed reconnaissance missions and carried out ground strafing attacks in the battle area, particularly during German withdrawals, such as at Falaise, and large scale

interdiction operations such as STRANGLE (May 1944) in Italy and CLARION (February 1945) in North-West Europe. Moreover, as the campaigns progressed and the likelihood of encountering the Luftwaffe decreased, many fighter squadrons were converted to fighter-bombers. Specific fighter-bomber squadrons were similarly often required to fly fighter missions, by acting as escort for medium bombers or by providing fighter patrols. To sum up, by 1944 the fighter aircraft fitted with bombs or rockets constituted the principal tactical air weapon. Its effectiveness in the close support role is the subject of the following chapters.

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2. Donald L. Caldwell, *J.G.26: Top Guns of The Luftwaffe*, (New York: Orion Books, 1991), pp.64-65.
3. Shores, op.cit., p.50.
4. The only dive bombers employed operationally by the RAF during World War II were US built single-engined, two-seater, Vultee Vengeance aircraft which equipped four RAF squadrons (Nos. 45, 82, 84, and 110) and two RIAF squadrons in the Far East, being first employed in Arakan in late 1942. They carried a 1,000-lb bomb load (two 500-lb or four 250-lb bombs), and usually attacked targets in a steep dive. Missions were usually flown by formations of six or twelve aircraft, and very often fighter escorts were provided. Vengeances proved successful in the close support role, though a report comparing dive bombers and fighter-bombers in close support compiled by RAF 3rd Tactical Air Force (of Air Command South East Asia) in September 1944 noted that 4th Corps considered Hurricane fighter-bombers more accurate. (PRO AIR 23/2514).
Detailed analyses of Vengeance operations are Air Headquarters India Tactical Memorandum No.35, *Vengeance Operations In Arakan* (May 1943) and South East Asia Command Tactical Memorandum No.1 *Employment of Vengeance Aircraft* (compiled by No.168 Wing RAF in December 1943), both in Air Command South East Asia reports on dive bombing, PRO AIR 23/2514.
Air Command South East Asia Tactical Memorandum No.5, *Dive Bombing*, (February 1944), compares operational experience of Vengeance aircraft in Australasia with that of Dauntless dive bombers in the Solomons, in *Dive Bombing: Combined Operational Data 1944*, PRO AIR 23/2830.
Vengeance operations are described in two works by Peter C. Smith, *Jungle Dive Bombers At War* (London: John Murray Ltd., 1987), and *Vengeance - The Vultee Vengeance Dive Bomber*, (Shrewsbury: Airlife Publishing, 1986). See also *Deadly Diving Accuracy*, his interview with Arthur Nurland Gill (Officer Commanding No.84 Squadron RAF 1942-44) in *Military History*, Volume 4, Number 6, June 1988, pp.18-24.
5. Shores, op.cit., p. 52.
In December 1940/January 1941 No.274 (Hurricane) Squadron flew some eighty operations of which ten (12%) were specific strafing attacks against Italian troop convoys and airfields. No.274 Squadron Operations Record Book, December 1940/January 1941, PRO AIR 27/1588.
6. No. 607 Squadron Operations Record Book, October 1941, PRO AIR 27/2093; Shores, op.cit., p.103.
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9. Bill Gunston, *The Illustrated Encyclopedia of Combat Aircraft of World War II*, (London: Tiger Books, 1990), pp.210-213; Operations Record Book of No.112 Squadron RAF, May 1942, PRO AIR 27/873.
10. Royal Air Force Narrative, *The North African Campaign, November 1942-May 1943*, pp.175-179, PRO AIR 41/33.
11. No.174 Squadron RAF Operations Record Book, August 1942, PRO AIR 27/1108.

12. Between July and September 1942 it was estimated that at least one Typhoon failed to return from each mission due to one or the other of these defects. See William Green, *Famous Fighters of the Second World War*, (London; Macdonald, 1960), p.103.
Details of the problems experienced when first converting the Typhoon to a bomber are in an RAF Report of 1944 entitled *Typhoon Bomber*, PRO AIR 37/798.
13. RAF 2nd TAF Report, *Tactics used by Day Fighter/Bomber Squadrons of 2nd T.A.F.*, (1945), PRO AIR 37/871.
14. Shores, op.cit., p.111.
15. Ibid., p.66 and p.152.
16. Peter C. Smith, *Close Air Support; An Illustrated History, 1914 To The Present*, (New York; Crown Publishers, 1990), p.82.
17. Ray Wagner, (Ed.), *American Combat Planes*, (New York; Doubleday, 1968), pp.84-85; Richard P. Hallion, *Strike From The Sky; The History of Battlefield Air Attack 1911-1945*, (Shrewsbury; Airlife Publishing, 1989), p.177.
Peter C. Smith refutes the view that dive brakes on the A-36A were usually wired shut. He quotes a former A-36A pilot who served with the US 525th Fighter Bomber Squadron, John B. Watson, who told him that he could not recall *'..participating in any mission, as a wing man or a flight leader, when the brakes were not used if the bomb run began between 8,000 and 12,000 feet and the dive was vertical.'*
Quoted in *Close Air Support*, op.cit., p.96.
18. Enzo Angelucci with Peter Bowers, *The American Fighter; The Definitive Guide to American Fighter Aircraft from 1917 to the Present*, (Yeovil; Haynes Publishing, 1987), pp. 163-164 and pp.166-167; Green, op.cit., pp. 46-49; Gunston, op.cit., pp.210-213.
19. Order of Battle, Royal Air Force and United States Army Air Forces, Appendix 4(a) to C.J.C. Molony, *The Mediterranean and Middle East*, Volume V, (London; HMSO, 1973), pp.874-875.
Neither the RAF nor the USAAF employed the P-40 operationally in North-West Europe. In Italy in 1945 some RAF and Commonwealth squadrons were still equipped with the later Kittyhawk variants, but by this time USAAF squadrons in Italy had converted to the P-47 Thunderbolt.
20. Green, op.cit., p.88.
21. Ibid, p. 84 and p. 88.
22. Ibid, p. 88; Gunston, op.cit., pp. 249-250; Angelucci and Bowers, op.cit., pp.390-391 and pp. 394-396.
23. Shores, op.cit., p. 140.
24. Ibid, pp. 134-135.
Some RAF squadrons were equipped with the Thunderbolt, but not in Europe. In September 1944 P-47s became operational with No.261 Squadron in Burma, and by the end of the year seven RAF squadrons in Burma had similarly converted from Hurricanes. These squadrons were extensively employed in close support, and a study of their ORBs provides a good insight to the nature of close air support in that theatre, not least because their ORBs tended to be written-up in more detail than those of RAF squadrons serving in Europe. See for example the ORBs of Nos. 5, 79, 134, 123, 258, and 146 Squadrons for April 1945 giving detailing VCP-controlled airstrikes in close support of British and Indian troops clearing the Japanese-held villages of Kandaung, Thabyebin, Sadaung, Kalaywa, Thazi, Yamethin, Hletaikon, Kokkogaing, Pyinbongyi, Thamin, and Ingon. (PRO AIR 27/66, AIR 27/666, AIR 27/947, AIR 27/917, AIR 27/1531, and AIR 27/989 respectively). These provide detailed target descriptions, map references, the height at which bombing and strafing was carried out, the locations where individual bombs fell and an assessment of results, and the number of rounds fired in strafing the target.
25. Green, op.cit., p. 75.

26. Ibid, p.77.
27. Ibid.
28. Ibid. In 1944 an Allied Prisoner of War report observed that the Lightning was more feared than the Thunderbolt. This was because the Thunderbolt had a loud engine which could be heard from sufficient distance to give some warning of attack, whereas the Lightning approached with little noise, even at low level, and was often able to surprise men and vehicles in the open. Prisoner of War Interrogation Report A.D.I. (K), Number 382/1944, (Normandy, 24th July 1944), in PRO AIR 37/760
29. Shores, op.cit., p. 152.
30. Green, op.cit., p. 91 and p. 96.
31. Ibid, pp. 96-97.
32. Shores, op.cit., pp. 139-140.
33. Ibid, p. 146.
34. RAF Desert Air Force Study (1944), *Fighter Bombers* in *Employment of Fighter Bombers (Policy)*, PRO AIR 23/1826.
35. Table based on The USAAF Evaluation Board in the European Theater of Operations, Report #33, *Tactics and Techniques of the Tactical Air Commands in the ETO* (1946), reproduced in William A. Jacobs, *Tactical Air Doctrine and AAF Close Air Support in the European Theater, 1944-1945*, Aerospace Historian, 27/1, Spring, March 1980, p.47.
36. Headquarters Mediterranean Allied Air Forces ORS Report No.32 (1945), *Observations on the Strength and Balance of Desert Air Force*, PRO AIR 23/7513.
37. Ibid.
38. Gunston, op.cit., p.109.
39. Shores, op.cit., p. 152.
40. Gunston, op.cit, p.109.
41. RAF Desert Air Force Study (1944), *Fighter Bombers* op.cit.; ORS M.A.A.F. Report N.32 (1945) *Observations on the Strength and Balance of Desert Air Force.*
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43. Ibid.
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63. Alfred Price, *The 3-inch Rocket: How Effective was it against the German Tanks in Normandy?*, Royal Air Force Quarterly, Summer 1975, p.129.
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66. H.G. Pattison (former Flying Officer, No.182 Sqn RAF) quoted in Norman Franks, *Typhoon Attack*, (London: William Kimber, 1984) p. 150.
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68. Shores, op.cit., p. 155.
Rocket use by US fighter-bombers was more extensive in the Pacific and Far East, especially after the more efficient zero-length underwing rocket rails became available in greater quantity during early 1945. See ibid, pp. 179-180.
69. Ibid., p.124 and p.133.
Rocket-equipped Hurricane IVs of No.6 Squadron arrived in Italy in March 1944, but operated mainly over the Adriatic and Yugoslavian coast against shipping. They carried an asymetric load; a 45-gallon auxiliary fuel tank under one wing and four rockets under the other. Hurricane IVs also equipped No.20 Squadron in Burma in 1944-45, serving as rocketeers providing close support for British troops, but by European war standards the aircraft was then obsolete.
70. Colgan, op.cit., pp.130-131.
71. RAF 2nd TAF 1945, *Tactics used by the Squadrons of the 2nd Tactical Air Force*, pp.9-10.
72. Colgan, op.cit., p.44.
73. ORS 2nd TAF Report No.20 (1945), *The Accuracy of Rocket Firing at Armament Practice Camps*, PRO WO 291/1349.
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79. ORS 2nd TAF Report No.36, op.cit.
These figures give a different impression from the quote referenced at note 42 above. Some squadrons became adept at bombing after pilots had gained experience, though targets such as bridges were very difficult to destroy. Group Captain D.E. Gillam, who commanded No.146 (Typhoon) Wing in North-West Europe recalled that bridges, *'..were almost impossible to destroy or damage even with 1,000 lb bombs. You were very lucky if you got a hit, and so often they glanced off and fell in the river..'* Quoted in Franks, op.cit., p.215.
Sometimes squadrons were lucky. Typhoons of No.198 Squadron, each with two 1,000lb bombs, destroyed the bridge at Vianen near Utrecht on January 5th 1945 after attempts by several squadrons had previously failed. In May 1944, twelve P-47s of the US 365th Fighter Group bombed the railway bridge at Vernon, France, with such success that details were circulated throughout the Allied tactical air forces. See Headquarters 365th Fighter Group Report (14th May 1944), *Report on Low-Level Attack on Railway Bridge at Vernon, France*, PRO AIR 37/805.
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CHAPTER IV.

THE FLYING SPEARHEAD:

CLOSE SUPPORT FOR ALLIED MOBILE & AIRBORNE OPERATIONS.

Introduction.

This chapter focuses upon close air support by fighter-bombers during operations when Allied troops possessed limited firepower; namely armoured thrusts and airborne operations. Such operations saw artillery relegated to a secondary role in favour of airpower. In the case of armoured thrusts this was because the tanks, if they succeeded in breaking through German defensive positions, would penetrate beyond the range of their supporting artillery, the bulk of which would also be outpaced by the advance.

The solution to this problem was the provision of continuous close air support for armoured spearheads during daylight. Particularly by the Americans in North-West Europe, the fighter-bomber and the tank were welded into an effective offensive combination that exceeded even the German developments in air/tank integration during 1940-42.

Regarding airborne operations conducted beyond the range of positioned friendly artillery, artillery support was limited to those pieces which could be transported to the dropping zone; in 1944 these were few and of relatively light calibre.| This was in line with the nature of airborne operations, which were essentially coup de main tasks demanding the rapid seizure of limited but important objectives and their retention until early relief. Once landed, however, lightly equipped airborne units were extremely vulnerable to counterattack by conventional troops supported by heavy weapons. Close air support was then the only means of delivering essential fire support for these forces.

I. THE FIGHTER-BOMBER/TANK COMBINATION.

Successful deep penetration by armour depended upon maintaining the momentum of the attack after the initial breakthrough. Beyond the range of friendly artillery, armoured units depended upon speed and their intrinsic firepower to (preferably) bypass or, if necessary, overcome resistance. During 1940-42 the Germans demonstrated that this firepower could be successfully augmented by close air support, aircraft

acting as 'flying artillery' to strike at targets in the path of the advance. Luftwaffe liaison officers in radio-equipped armoured cars accompanied the panzer columns, and were able to call upon Ju.87 'Stuka' dive-bombers that were already over the battle area or waiting at readiness on the hastily occupied airstrips that leap-frogged in the wake of the advance.2 The invasion of Russia in June 1941 saw the panzer units accompanied by Luftwaffe tank liaison officers, riding in their own UHF-equipped tanks and in contact with air units.3 This enabled targets to be bombed shortly after being encountered, and in 1942 RAF Intelligence estimated that Stuka attacks could be carried out within 15/20 minutes of the original support request, though this was considered 'exceptional'.4

The campaigns in Italy and North-West Europe in 1943-45 were characterised by the need to break a stubborn German defence through a lengthy and costly process of attrition.5 However, there were occasions when, after German defence zones had been broken, mobile operations were possible. The problem then was how to sustain an advance before German forces could seal the breach. During the breakout from Normandy in July/August 1944, when US armour had to penetrate through and beyond the hedgerow-lined roads of the *Bocage*, which were ideally suited to defence, success was largely due to an innovation in air support

carried out by the US 9th Air Force and which became known as 'Armored Column Cover'.

Armored Column Cover & Cabrank.

Armored Column Cover was the provision of continuous air support for the US armour. Flights of four P-47 Thunderbolts, relieved by another flight approximately every 30 minutes, were maintained over the armoured spearheads during daylight. Controllers in the lead tanks communicated with the flight leaders by VHF radio and could thus call down strikes when required or request searches of the roads ahead of the column. The usual procedure was for the arriving fighter-bomber flight to check in by radio with the ground controller and, when relieving another flight, with the leader of the flight already present. This allowed any targets encountered to be attacked at once, and enabled the incoming pilots to be warned of likely areas of German resistance. During periods of rapid advance and little German ground opposition, the flight leaders often patrolled ahead of the column, sometimes at a distance of up to 30 miles along the axis of advance, searching for any German troops, tanks or gun positions.6

Armored Column Cover was put into effect on July 26th 1944, the second day of Operation COBRA, and

immediately proved effective in overcoming the ad hoc German defensive positions and strongpoints hastily thrown together to halt the US advance. The fighter-bombers literally cleared the roads ahead of the US tanks, a typical example being the air support provided for Combat Command A of the US 3rd Armored Division on July 31st. A task force commanded by Colonel Doan had succeeded in cutting the Villedieu - Granville road late in the afternoon when a message was received from VII Corps ordering Doan to proceed a further 12 miles to the final objective, Hill 242 near Brecy. When his force approached a defended rail embankment Doan requested his column cover P-47's to strafe the tracks, their last mission for the day as light was fading. As the US tanks crossed the embankment unopposed their crews saw several unmanned German anti-tank guns. The morale effect of air attack coupled with the shock of an immediate armoured follow-up had induced their crews to remain in cover - though they subsequently returned to man their guns against the following US infantry.7

The main problem with Armored Column Cover was that implementing it required the commitment of considerable air effort. On July 28th 1944, the third day of its employment, column cover absorbed 22 per cent of the IX TAC's total available air resources, which in turn amounted to 61 per cent of the total of

those resources allocated to close air support.8 Further use of column cover on occasions in North West Europe saw these totals increase. A post-war USAAF study noted that the air effort that a TAC could make available for column cover rarely exceeded the requirements of three armoured columns, and that,

> *In general, this committment absorbed between 30% and 60% of the available air strength of a TAC, or approximately one* [fighter] *group per armored division.*9

Nevertheless, in Army opinion, this air effort was both necessary and worthwhile, a post-war report observing that,

> *The decision of the Ninth Air Force to give high priority to armored column cover in a fast-moving or fluid situation from the break-out in NORMANDY to the final drive across Central Europe made a successful contribution to the success of the ground units in breaking through and encircling the various elements of the German armies....This effort permitted our armor far greater freedom of action than would have been otherwise possible.*10

Such regular close integration with aircraft was never enjoyed by British armoured forces, but on occasions they received similar air support when provided on CABRANK. This was a method of providing continuous close air support during intensive, mostly large-scale, operations and was first employed in Italy during the assault to clear the line of the River Sangro in November 1943. It was devised by the (then) commander of the Desert Air Force, Air Vice Marshal Broadhurst. Flights of fighter-bombers were

detailed to proceed to an area of the battlefront likely to require air support. This area was called the CABRANK and on arrival the aircraft reported to the ROVER controlling that sector. They then orbited the area awaiting a call from the ROVER giving them a target. When this occurred, the pilots were able to attack after a short target briefing had been given by the ROVER, and often after the target had been indicated by coloured smoke rounds. It was usually possible for targets to be attacked within 10 minutes of the original request and for repeat attacks, if required, to be made within 30 minutes by subsequent flights arriving in the battle area.||

That British armour was capable of successfully exploiting fighter-bomber support when provided on CABRANK can be seen in two operations, one in North-West Europe and the other in Italy.

OPERATION 'GARDEN'.

This was the offensive launched by British Second Army as part of MARKET GARDEN in Holland on the afternoon of September 17th 1944, for which the Guards Armoured Division was to spearhead the XXX Corps advance along the single road leading to Eindhoven and ultimately to Arnhem. In order to facilitate an armoured breakout along a single axis of advance, lined on each side by

streams and marshy ground preventing the deployment of armour and by woods concealing German anti-tank guns and infantry, the Corps commander, General Horrocks, decided to employ an extensive artillery programme supplemented by close air support by rocket-firing Typhoons.12 One Typhoon squadron was to attack along the road immediately after the barrage ended, while a further ten squadrons were thereafter to maintain CABRANK for the armour. The 2nd Irish Guards (tanks) were to spearhead the attack along the road, while the flanks were to be cleared by infantry of 2nd Devons.13

At 2.15 pm the artillery barrage began, a belt of fire one mile wide and five miles deep timed to work its way across the German positions ahead of the Guards' tanks and their supporting infantry, fired by ten field regiments, three medium regiments, one heavy battery of 8-inch guns and a regiment of heavy anti-aircraft guns employed in the ground role.14 This fire was impressive, a witness later recalling that,

> *...the missiles screamed over us unceasingly, the fountains of their bursts clearly visible to the leading troops straight up the road beyond the start line.*15

Then followed the arrival of the Typhoons, flights arriving approximately every five minutes to rocket and strafe each side of the road. At 2.35 pm the Irish Guards began the advance, their lead tanks following the barrage closely. For the first ten minutes the

advance went smoothly, the tanks gaining over 1,000 yards and the German defences apparently subdued by the combined weight of artillery and airborne firepower.16 However, shortly afterwards the crews of the lead tanks heard the thump and clanging of anti-tank action behind them.

The Germans had concentrated a battle group under the command of Oberst (Colonel) Walther to block the approaches to Eindhoven. (*Kampfgruppe Walther*) consisted of some ten weak infantry battalions, supported by self-propelled guns and 88mm anti-tank guns, but the defence of the road leading to Valkenswaard along which the British tanks were advancing had been entrusted to Major Kerrut. Kerrut had immediately to hand a battalion of infantry with heavy weapons and supported by a battery of howitzers. On September 13th he had been reinforced by a troop of 88mm guns, and also some triple-barrelled 20mm anti-aircraft guns. Kerrut's troops were well dug-in and camouflaged in trenches cut into the verges on both sides of the road and along the fringes of the woods, with their fields of fire crossing in enfilade.17

On the afternoon of the 17th they had held their fire until the barrage and the leading British tanks had passed them, and then proceeded to knock out nine of the following tanks within two minutes. The situation for the Irish Guards was at once radically

transformed. A half-mile gap littered with burning tanks lay between the lead tanks and the following squadrons, the latter being unable to deploy off the road due to the marshy ground and dense woodland and unable to advance due to the wrecks blocking the road and the waiting German guns. The armoured thrust had been stopped cold, and artillery fire could not be brought down on the German positions due to the proximity of the British tanks.18

This was precisely the situation in which prompt close air support could make the difference between success and failure. The RAF controller in the contact car with the Irish Guards immediately called down the Typhoons waiting above on CABRANK. Within a few minutes, as the Guards' tanks began firing red smoke rounds to indicate the German positions, the Typhoons started to dive. The Irish Guards' War Diary describes what followed:

> *Typhoons were called for and answered immediately. In the next hour.. very low and accurate attacks* [were] *made on the enemy. Our tanks burnt yellow smoke abundantly and though the rockets landed within 100 yds of them, there was never any likelihood of a mistake, so sure was the pilots' aim. It is only true to say that but for the Typhoon Squadrons' support, our advance could not have continued.*19

The Typhoon attacks quickly and utterly demoralised the German troops. The Irish Guards War Diary recorded that the effect of the rockets,

> *...was almost instantaneous. Enemy came running out of the trenches trembling with fright and were sent*

*doubling down the road in very quick time. All were still running when they passed Div HQ a mile the other side of the bridge.*20

The 2nd Devons started to comb the woods and verges in the wake of the Typhoon attacks, and found many dazed and frightened German troops still crouching at the bottom of their slit trenches. They also found a self-propelled gun abandoned in such haste that its engine had been left running.21 The Typhoons were clearly more effective than supporting artillery fire could have been under the circumstances, and their morale effect more marked. By 3.30 pm, within an hour of the start of the advance, the Irish Guards and 2nd Devons had taken 250 prisoners. This was a remarkable turn of fortune in what had been a very doubtful situation.

However, the advance was not immediately resumed due to the Guards requesting a further medium artillery barrage and, as they were within 200 yards of its intended start line, they pulled back 500 yards. This barrage, of 20 minutes duration, was not put down until 5.39 pm, the tanks resuming the advance only at about 6 pm.22 Typhoons remained in support, but were now streaking above the road well ahead of the Guards engaging any targets they could see, clearing the route ahead in the same manner as with US Armored Column Cover. As they advanced the Irish Guards witnessed the effect of the Typhoon attacks on the

morale of the German troops as the prisoners began to come in:

> *One Warrant Officer from an anti-tank Coy. said he had owned 10 7.62 Russian guns before the battle but none were now left working and very few of his crews alive. He could not decide which was worse, the rockets or the Browning and was sent weeping down the road.*23

Four German 88mm guns and their towing vehicles were also captured intact:

> *They were from 602 Heavy AA Bn, and the crews were in a great state of fear.*24

This demoralisation was achieved, in some cases, without rockets or cannon being fired, as the Typhoons stayed with the Guards even though they had expended their rockets and cannon ammunition, making dummy attacks on the German positions that proved equally effective in subduing them. That this was appreciated by the Guards is recalled by a former Typhoon pilot who remembers that,

> *We received a very nice signal from the Division, saying thanks for staying with them even though we'd run out of ammunition.*25

The German force defending the road to Valkenswaard had been overwhelmed by the combined air and ground assault. In the early afternoon the headquarters of *Kampfgruppe Walther* reported unusually heavy Allied fighter-bomber activity in Major Kerrut's sector. All vehicle movement as far as Eindhoven came to halt as a result of their presence, and Oberst Walther's own combat headquarters near Valkenswaard was attacked

several times from the air. Further reports came of a very heavy British artillery barrage falling on the defence positions along the road, and soon afterwards telephone communication with Kerrut was lost. At 2.30 pm a staff officer sent forward from Walther's headquarters reported that British tanks had broken through on both sides of the road and had overrun one of Kerrut's infantry companies. They were being engaged by Kerrut's supporting anti-tank guns, with the German guns coming under heavy fire.

By 5 pm it was known at Walther's headquarters that a further company of Kerrut's infantry had been overrun and that his 88mm guns, lacking the mobility to change positions under fire, had been lost and their commanders killed. British artillery fire was now falling close to Valkanswaard and Major Kerrut, with the remains of two infantry companies and a few of his howitzers and 20mm guns that had been extricated, was attempting to organise new positions. At about 7 pm Walther's headquarters reported to their parent formation, First Parachute Army, that the remaining forces near Valkenswaard were too weak to sustain any defence.26

By 7.30 pm the Irish Guards reached Valkenswaard, where they were to halt for the night - though Eindhoven had been the day's intended objective. They had lost nine tanks destroyed at the outset of the

attack, with eight men killed and several wounded. The 2nd Devons had lost twelve men killed and twenty-two wounded.27 Typhoons had ceased to operate on the XXX Corps front at 7.26 pm, as dusk was falling; No.83 Group had flown 233 close support sorties.28

September 17th showed what the air-tank combination could achieve, and can be contrasted with subsequent days when air support was unavailable. On September 21st at 11 am the Irish Guards were ordered to advance North along the main road from Nijmegen to Arnhem. Once again they were confronted by a road defended by German infantry dug-in with anti-tank guns. According to the British narrative,

> *At 1330 hours the advance started and at 1350 hours it finished, when the 3 leading tanks were knocked out, as they came into view of the..enemy position.*29

Only one regiment of field guns was available to support this attack, and its fire was ineffective. Inexplicably, no artillery FOO able to direct fire appears to have been with the Irish Guards.30 Moreover, while Typhoons were above on CABRANK, they could not be called down because at first the VCP control set broke down, then later in the afternoon the fly-in of Polish airborne reinforcements to the Arnhem area automatically banned the use of close support aircraft.31 Infantry of 3rd Irish Guards, who had been riding on the tanks, tried to advance but were repulsed, as was an attempted right flanking

movement. Finally, at 6.30 pm the Irish Guards drew back 1,000 yards to harbour for the night.32

'GARDEN' was an operation largely compromised by the fact that XXX Corps had to advance for a considerable distance (some 46 miles) along a single axis. When air support was not available due to the complication of airborne drops, poor weather, or simply bad luck as on September 21st, then little, if any, progress was made.33

OPERATION 'CYGNET'.

An operation in Italy in early 1945 was more successful due to its limited objective. By early January 1945 the British V Corps of Eighth Army had closed up to the line of the River Senio except where a pocket of German resistance remained around Alfonsine, just North of Faenza. This pocket, roughly box shaped with sides about 4,000 yards long, was held by some four battalions of infantry of the German 278th Infantry Division supported by about 6 tanks and self-propelled guns. From North to South, the pocket was contained by the 1st Canadian, British 56th, and 2nd New Zealand Divisions.34

Despite the importance of eliminating the pocket, V Corps could not mount an assault due to a severe shortage of artillery ammunition in Eighth Army. For

this reason a planned full-scale attack involving the Canadians and New Zealanders had been cancelled. Moreover, due to a shortage of replacements, V Corps ordered that 56th Division - which consisted of only two infantry brigades - should not itself attempt a major effort. After 56th Division had mounted a series of 'nibbling' attacks, which the Germans stubbornly and successfully resisted, its commander, Major-General Whitfield, was directed to prepare a plan for eliminating the pocket using the only reinforcements that could be spared - an armoured brigade and, for their first employment in Italy, sufficient Kangaroos (armoured personnel carriers) to carry a battalion of infantry.35

The result was Operation 'CYGNET', an armoured sweep through the pocket by 7th Armoured Brigade with two armoured regiments, 10th Royal Hussars on the right and 2nd Royal Tank Regiment on the left, and a battalion of infantry, 2/6th Queens Royal Regiment, following the tanks in Kangaroos and prepared to debus rapidly to mop up points of resistance. Success depended upon two factors. The first was surprise. A series of heavy frosts permitted the employment of tanks cross-country but the Germans, who had mined the main routes, did not expect such a weight of armour to be deployed against them and remained unaware of 7th Armoured Brigade's concentration. The second factor

was a heavy scale of close air support. To compensate for the lack of artillery the Desert Air Force provided extensive fighter-bomber cover, commencing with a heavy strike on the German positions at the outset of the armoured advance and following this with CABRANKS of Spitfires continuously on call, through the ROVER tentacle at 7th Armoured Brigade Headquarters, to bomb and strafe just ahead of the leading tanks.36

'CYGNET' started at first light on January 4th and proved highly successful, a subsequent Royal Armoured Corps study noting that,

> *The enemy were paralysed with surprise by this weight of armour suddenly sweeping through them from an unexpected direction..37*

The German defence was thrown off balance by the combined air and armoured assault, and those German troops who attempted resistance were soon overcome either by the tanks or the waiting fighter-bombers. The History of 2nd Royal Tank Regiment indicates the extent to which the air support was relied upon during the attack, and how close to the British armour the fighter-bombers engaged targets:

> *We..called down air support on practically every house as we reached it. A cab-rank was kept overhead throughout the day and we used every sortie that the R.A.F. were able to lay on. We got first-class support, usually a hundred or two hundred yards ahead of our tanks.38*

In an operation lasting some 10 hours the Desert Air Force had flown 116 fighter-bomber sorties in support of the British armour, which had secured 12,000 square yards of territory and taken over 300 prisoners. Casualties to the attackers were extremely light; 3 tanks bogged and 6 men slightly wounded in 10th Hussars, 5 tanks (3 later recovered) and 10 men wounded (one of whom later died) in 2nd RTR, and 7 infantrymen of 2/6th Queens wounded.39 The most important factor in preventing any organised German resistance, and thereby maintaining the momentum of the advance, had undoubtedly been the airstrikes made in immediate response to potential or actual opposition. The subsequent Royal Armoured Corps study of 'CYGNET' observed that,

> *Whenever air support was given it caused a temporary disorganisation of the enemy in the houses and enabled the tanks to close in without casualties.*40

Armored Column Cover and both 'GARDEN' and 'CYGNET' indicate that in mobile operations close air support was more appropriate and effective than artillery because fighter-bombers were able to deliver fire support with greater accuracy in close proximity to friendly troops under fluid battle conditions. They could also keep pace with a rapid advance whereas artillery often could not, not least because of transport and maintenance difficulties. In North-West Europe, during the pursuit after the crossing of the

River Seine, British Second Army covered 250 miles in six days but to make sufficient transport available an entire Corps (the 8th) and most of the army artillery had to be left behind around the Seine for some weeks.41

An obvious question is whether self-propelled (SP) artillery offered an alternative solution to the problem of fire support for mobile operations. US armoured divisions were equipped with three battalions of SP guns, each with eighteen M.7 105mm howitzers on Sherman chassis. Their British counterparts had only one regiment of twenty-four Sextons, self-propelled 25-pounders on the chassis of the Canadian Ram tank, the other regiment being of conventional towed guns.42

SP guns offered important advantages over towed pieces. One was that they combined mobility and firepower with protection for the gunners, enabling the guns to provide close-in support from hull-down positions without the delay caused by unlimbering and digging gunpits. They could deploy quickly, and change position rapidly in action if necessary, while on the move they took up less road space. However, on occasions when speed was essential they still took time to deploy and register targets, and there was always the factor of the limited supply of ammunition carried on board and the frequent need to replenish. In North-West Europe, as the numbers of available US

tanks increased, US armoured divisions relied increasingly on the armament of their tanks, with artillery required only in set piece operations. Hence their reliance on Armored Column Cover when tanks could not generate sufficient firepower.43

In British experience, the principal drawback with SP guns was the level of maintenance required to keep them roadworthy. Tracked vehicles were susceptible to mechanical breakdown, and the guns were usually either in action or on the move a high proportion of the time. Moreover, breakdown meant shortage of a gun, whereas with towed pieces another tractor was simply hooked to the gun. Another problem was that SP guns had a high profile and were difficult to conceal.44

To sum up, SP artillery did not obviate the need for close air support during mobile operations. Had SP 25-pounders been present with the forward tanks of Guards Armoured on September 17th they would not have been able to extricate them as had the Typhoons, not least because of the limited traverse of their guns, and, like the tanks, they would have been unable to deploy off the road. They would also have been as vulnerable, indeed more so, to the German anti-tank fire. During 'CYGNET' they might have provided close-in support for the tanks as strongpoints were encountered, but in fact would have been subject to the severe shortage of 25-pounder ammunition that had dictated the nature of

the operation. There were also different morale and proximity characteristics between artillery and close air support, and these are considered in Chapter VII below.

II. AIRBORNE OPERATIONS.

The defining characteristic of airborne operations was that their execution was dependent upon air capabilities; delivery to the drop/landing zone, sustaining of the landed airborne forces with supplies and reinforcements, and the augmenting of firepower by air support all depended upon the air forces. Experience in North-West Europe indicated that with regard to the latter task Allied airborne forces were poorly served. However, this must be qualified by some general observations with regard to airborne operations.

First, it was impossible to provide close air support for airborne troops when they most needed it - when they were at their most vulnerable while dropping out of the sky. Air attacks upon enemy defensive positions could immediately precede a drop, but the risk to the airborne troops was too great to permit airstrikes either during the drop or immediately

afterwards, when the scattered airborne troops were organising. Thus if the defending troops had been unaffected by the preliminary air bombardment, or had recovered from its effects, those paratroops unfortunate enough to land among them stood little chance of survival. This was a lesson learnt by all combatants who employed airborne forces.[45]

Second, even once paratroops and/or glider-borne troops had landed, had organised as far as possible, and were attempting to take their assigned objective, it was still by no means straightforward to provide close air support. This was because pilots could not be expected easily to distinguish friend from foe on the ground in a battle taking place beyond the established front lines, and were reliant upon the airborne troops indicating their own and the enemy's positions by pre-arranged signals or radio communication. However, this was a process fraught with danger; during the German airborne invasion of Crete in May 1941 British and Commonwealth troops soon learnt that to engage the German paratroops closely meant that German aircraft, ever overhead in daylight, could not intervene in the fighting for fear of hitting their own men. It was even sometimes possible to imitate the paratroops' Very light signals to their supporting aircraft, and on at least one occasion in

Crete the Luftwaffe was induced to attack German troops.46

Third, whereas the German airborne troops had relied on a series of light signals for contacting aircraft, Allied airborne forces by 1944-45 relied on radio equipment manned by air contact teams landed with the airborne troops. Here too was a risk, for airborne forces had to anticipate casualties as a result of jumping accidents or glider mishaps before coming into contact with the enemy, while losses to strength due to scattered drops - often miles away from the intended landing zone as had occurred in Sicily - were another hazard. A misplaced air contact team, or radio equipment lost or damaged in the drop, could mean no communication with aircraft and no air support.

Normandy.

The first major Allied use of airborne forces in North West Europe indicated that little consideration had been given to the provision of close air support. A frank post war US study observed of the airborne landings in Normandy that,

> *It is fortunate that a link-up was made on 8 June between airborne troops and the beachhead, since both fighter bomber cooperation, and aerial reconnaissance information were insufficient for those lightly armed isolated units.47*

Most missions flown in support of the airborne forces were in the nature of pre-planned strikes against bridges and lines of communication leading to the airborne landing areas, in effect battlefield air interdiction. This no doubt reduced the potential number of German troops and their supporting armour to be confronted, but had small effect upon those German forces already in position in the landing area. There was little close support, not because the aircraft were lacking, but because the command and control machinery was not in place. As the same US study pointed out,

> *Request missions on critical close targets were practically non-existent; those effective were "stolen" from the air by circumventing the unwieldly procedure and channel set up, and by "talking the pilot" into the target...More help might have been requested but casualties to TALO's and equipment in the drop reduced their potential effectiveness...Losses to airborne units on the ground through lack of close support by fighter bombers were out of proportion considering the number of fighter bombers over the invasion area.*48

Operation 'MARKET'.

That little had been done to solve the problem of command and control of close air support for airborne forces became apparent during Operation MARKET in September 1944. It seems remarkable that the airborne forces remained unfamiliar with the air support system by then in regular use by Allied troops on the

Continent. The most likely explanation for this is, as Shelford Bidwell and Dominick Graham suggest, that the airborne divisions remained isolated from the mainstream of military experience.49 In any event, as late as September 1944 First Allied Airborne Army had no Air Support Signals Unit (ASSU) or training in air/ground cooperation, and although a staff officer from 1st British Airborne Division had been sent to Normandy to learn at first hand how air support was arranged, nothing had resulted.50

At the outset of the operation, each airborne division was allocated two US air support parties, while one was allocated to First Airborne Corps Headquarters. This was much in the nature of an afterthought. These parties had no experience of working with the troops they were to accompany, and the operators were even unfamiliar with their radio sets. Those that accompanied 1st Airborne Division to Arnhem proved a failure; neither ever succeeded in contacting aircraft by radio and both were put out of action by German mortar fire.51 This alone would have been enough to rule out effective close support for, as a US study later pointed out,

> *Without ground control of the aircraft, to talk it into a target, the bomb line becomes a restriction denying the close support which the airborne units needed and didn't get.*52

Apart from the inability of the airborne troops to communicate with aircraft, there was another major factor in the lack of close air support. This was the fact that the experienced Allied tactical air forces already established on the Continent, in particular No.83 Group of RAF 2nd TAF and the IX TAC of US 9th Air Force, were prevented from intervening at crucial periods during the operation. This was because of a ruling that prohibited them from operating in the battle area when troops or supplies were being landed or dropped - the aim being to prevent close support aircraft of the tactical air forces becoming mixed up with the fighter escort from England, with unfortunate result.53

Responsibility for the preliminary bombardment of German flak batteries en route to and in the landing areas, and for the escort of the transport and supply aircraft, was assigned to the US Eighth (Strategic) Air Force, whose UK-based fighter groups had no experience of ground support operations. In effect, tactical air force operations were controlled from England, and when adverse weather prevented the take-off of transports there, or during the frequent changes in planned programmes for airdrops and landings, the close support aircraft remained grounded too. The result was that close air support for the Airborne Corps during the operation between 17th-25th

September was scant and irregular, being provided on only five days. On the 18th, close support sorties flown for the US 82nd Airborne Division around Nijmegen totalled 97, while on the 22nd some 119 sorties were flown in close support of the US 101st Airborne Division fighting near Eindhoven. British airborne troops at Arnhem saw supporting Typhoons for the first time on the 23rd, when a few sorties were provided by No.83 Group, but they received their first significant close support only on the following day, the 24th (a week after the start of the operation), when 22 sorties were provided. A further 81 Typhoon sorties were provided on the 25th.[54]

No.83 Group was well aware of the plight of 1st Airborne at Arnhem, fighting for its life against the troops and tanks of 9th and 10th SS Panzer Divisions, through the 'Y' army radio intercept service, but its repeated pleas to be able to release the Typhoons standing armed and ready on its forward airfields were disregarded.[55] However, given that the German infantry and their supporting tanks were closely engaging the British airborne troops in the town, it is unlikely that the Typhoons could have identified their targets adequately enough for them to intervene directly in the fighting - particularly in view of the lamentable state of 1st Airborne's communications.[56] Nevertheless, they could have initially assisted the

paratroops to seize their objectives, and afterwards struck at the German tank and troop concentrations in and around the town, harassing movement. This had been expected by the commander of 1st Airborne, Major-General Urquhart, who later wrote that,

> *The lack of close air support was a surprise to us. In the first two or three days before the flak started to build up, low-flying rocket aircraft would have been invaluable...rooftop attacks by Allied fighters on tanks in the streets would have made a lot of difference.*57

As it was, the Germans destroyed 1st Airborne largely unmolested from the air. Appearing over Arnhem in any strength only on September 24th, the Typhoons were too late to affect the ultimate outcome of the battle. Moreover, in the absence of direct ground-air communications, support requests had to be channelled from First Airborne Division through 64th Medium Regiment Royal Artillery (of XXX Corps whose guns were then in range), to Airborne Corps, thence to Second Army, then to Headquarters 2nd TAF and finally to No.83 Group. Even under these circumstances their morale effect was remarkable. A witness later recalled that,

> *..the presence of these aircraft over the battlefield was still of inestimable value. Not only were the German mortarmen and gunners reluctant to man their weapons when the aircraft - fearsome-looking, with shark's head and jaws painted on the machine's nose - were overhead, but the effect on the morale of the airborne soldiers, given even a temporary respite from bombardment, was tremendous..*58

The Rhine Crossing.

On March 24th 1945 the Allied assault across the River Rhine was spearheaded by the landing of the British 6th and US 17th Airborne Divisions. On this occasion, the last large-scale use of airborne forces in North-West Europe, the lessons of previous operations appear to have been learned.

Three Forward VCP's were landed by glider with 6th Airborne Division, one being in operation controlling air support from 2nd TAF within two hours of landing.59 Although this was a vast improvement on Arnhem, communications still left something to be desired and air support did not function without some difficulty, as seen in an example from March 25th. The 6th Airborne Division tentacle requested aircraft on CABRANK to attack some German tanks positioned in an orchard. Two air attacks were unsuccessful because the ground controller was unable to describe exactly the position of the target. The FCP staff eventually decided to deal with 6th Air Landing Brigade direct, as the German tanks were only 250 yards from its positions, but the latter had no ground to air communications. In the event the FCP Controller used a reconnaissance photograph of the area as a guide to his briefing of the aircraft, and he was kept informed of the result of the attacks by means of a running

commentary from the forward tentacle. After seven attacks directed in this cumbrous manner the German tanks eventually dispersed.60

The US airborne units had also been better equipped with ground-air communications for the Rhine operation, an air support party with 17th Airborne Division being operational on the afternoon of March 24th, while on the next day several close support strikes were directed, one within 10 minutes of the original request.61

CONCLUSION.

Experience in 1944-45 suggested that close air support was a prerequisite for successful armoured thrusts, particularly when the axis of advance was narrow and when any significant opposition was likely. The main value of fighter-bomber attack appears to have been in its morale effect, the neutralization of German defences, albeit temporary, rather than actual destruction or casualties caused. By being able to engage targets closely, sometimes to within 100 yards of friendly tanks, fighter-bombers could offer greater opportunity to exploit this neutralization than permitted by artillery fire. Moreover, they offered

the only means of providing continuous support throughout an advance.

Similarly, close air support offered the only means of augmenting the firepower of airborne troops operating beyond the range of friendly artillery. Yet the importance of air support for such troops does not seem to have been sufficiently realised by Allied air and ground commanders in 1943-45. While there were command and control problems with providing close air support for troops operating far beyond the battlefront, these could be solved, mainly by the provision of adequate ground-air communications - as the Rhine crossing proved. Without such support, or a very rapid link up with friendly ground formations, airborne troops were likely to be destroyed - perhaps the most obvious lesson from the Arnhem debacle.

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12. War Office Narrative, *Liberation Campaign North-West Europe*, Book III, Chapter V, *Phase 5 The Advance From The Seine To The Siegfried Line and the Battle for Arnhem 29 August-30 September 1944*, p. 27, PRO CAB 44/254; Guards Armoured Division War Diary, Appendix C, Notes on road from Dutch frontier to Arnhem, September 1944, PRO WO 171/376.
13. War Office Narrative, op.cit, p.43.

14. Ibid, p.40.
15. Captain The Earl of Rosse, M.B.E., & Colonel E.R. Hill, *The Story of the Guards Armoured Division*, (London: 1956), p.127.
16. War Diary, 2nd (Armoured) Irish Guards, 17th September 1944, PRO WO 171/1256.
17. *Battle Group Walther*, German account of the defence of the Valkenswaard area, compiled post-war, copy held at the Imperial War Museum, London; Anthony Farrar-Hockley, *Airborne Carpet*, (London: Macdonald, 1970), p.104; Robert J. Kershaw, *It Never Snows in September* (Marlborough: Crowood Press, 1990), pp. 45-46.
18. Rosse & Hill, op.cit., p.128.
19. War Diary, 2nd (Armoured) Irish Guards.
20. Ibid.
21. War Diary, 2nd Battalion the Devonshire Regiment, September 17th 1944, PRO WO/171/1278.
22. War Office Narrative, op.cit.
23. War Diary, 2nd (Armoured) Irish Guards.
24. Ibid.
25. H. Ambrose, (Forner Flight Lieutenant, No.175 Squadron RAF), quoted in Norman Franks, *Typhoon Attack*, (London: William Kimber: 1984), p. 156.
26. German account, *Battle Group Walther*, op.cit.
27. War Diary, 2nd (Armoured) Irish Guards; War Diary, 2nd Devons.
28. No.83 Group Daily Intelligence Summary, September 17th 1944, PRO AIR 25/705.
29. War Office Narrative, op.cit.
30. Ibid.
31. Ibid.
32. Ibid.
33. The question of whether the British armour displayed a lack of necessary drive and determination to reach Arnhem is discussed by Geoffrey Powell in *The Devil's Birthday: The Bridges to Arnhem 1944*, (London: Papermac, 1985), pp.162-163 and pp.239-240.
The armour was clearly unwilling to advance without assured artillery and/or air support and it was accepted doctrine in British and Commonwealth armies by 1944 that such support was essential for an armoured advance. Commanders willing to risk advancing without it were censured. During a tactical exercise in Italy run by the 5th Canadian Armoured Division, which postulated that its 5th Brigade had seized an objective and was contemplating further advance in the face of a disorganized enemy, the Brigade Commander (Brigadier Bradbrook) queried the need to waitfor supporting artillery to move up when he already had over 150 guns - on his tanks. He was subsequently fired by his Division Commander, Lieutenant-General G.G. Simonds, who was to command 2nd Canadian Corps in North-West Europe. John A. English, *The Canadian Army and the Normandy Campaign: A Study of Failure in High Command*, (New York: Praeger, 1991), pp.271-272.
34. Royal Armoured Corps Pamphlet: *Armoured Operations in Italy, May 1944-January 1945*, p.77.
35. Ibid.
36. Ibid; Royal Air Force Narrative, *The Italian Campaign 1943-1945*, Volume II, *Operations June 1944-May 1945*, PRO AIR 41/58.
37. Royal Armoured Corps Pamphlet, p.78..
38. *Seconds Out, A History of The 2nd Royal Tank Regiment*, by Sergeant Chadwick, (undated) Volume II, p.283.

39. *The 10th Royal Hussars in the Second World War 1939-1945*, the Regimental Committee (Aldershot; Gale & Polden, 1948), p. 158; Major R.C.G. Foster, *History of the Queen's Royal Regiment*, Volume VIII, 1924-1948, (Aldershot; Gale & Polden, 1953), p.456; 2nd Royal Tank Regiment Report (1945), *Account of Operation "CYGNET"*, PRO WO 204/7989.
40. Royal Armoured Corps Pamphlet, p.81.
41. A.L. Pemberton, *The Development of Artillery Tactics and Equipment*, (London; The War Office, 1951) p.234.
42. B.T. White, *Tanks and other Armoured Fighting Vehicles 1942-45*, (Poole; The Blandford Press, 1975), pp. 104 & 119.
43. Bailey, op.cit., pp.195, 206.
44. British 21st Army Group Report, (undated, but likely 1945), *Self Propelled Artillery in 21st Army Group; Analysis of Opinions and Criticisms*, PRO WO 291/1336.
45. One example being the virtual destruction of the German III Parachute Battalion which landed on and near the positions of the 23rd New Zealand Infantry Battalion near Maleme during the invasion of Crete on May 20th 1941. Some 400 of this force of 600 paratroops are thought to have been killed either while descending or immediately on landing. Another example is the heavy casualties suffered by the US 3rd/505th Parachute Infantry landing in the face of an alerted German defence at St. Mere Eglise in Normandy early on June 6th 1944.
I. McD. G. Stewart, *The Struggle For Crete* (Oxford; 1966), pp.164-165, and John Keegan, *Six Armies In Normandy*, (London; 1982), pp.93-94.
46. A first-hand account of a spirited, aggressive and highly successful defence against paratroop attack by the Australian officer who directed it is *Report by Lt.-Col. I.R. Campbell, D.S.O., A.I.F. on the Defence of Retimo Aerodrome, Crete, 20-30 May 1941*, (1945), PRO CAB 106/382.
This was written by Lt.-Col. Campbell on his release from German captivity in 1945. His account provides an example illustrating the difficulty faced by ground attack pilots in identifying battlefield targets. During the fighting in Greece and Crete German pilots identified British troops by their dish-shaped steel helmets. In Crete, a party of British troops were taken prisoner at Canea, and immediately their German paratroop captors made them throw away their helmets into a nearby wadi. According to Campbell, *'..from then on this collection of helmets received a great number of bombs and machine gun bullets from German airmen...'*
47. General Bradley & the U.S. 12th Army Group Air Effects Committee, pp.143-144.
48. Ibid, p. 144.
49. Shelford Bidwell & Dominick Graham, *Fire-Power; British Army Weapons and Theories of War 1904-1945*, (London; Allen & Unwin, 1985), p.273.
50. Ibid.
51. Powell, op.cit, pp.171-172.
52. General Bradley & the U.S. 12th Army Group Air Effects Committee, p.144.

53. Allied tactical aircraft were frequently attacked in error by friendly aircraft, US and British pilots often failing to recognise each others aircraft types. In his study of the Normandy campaign Max Hastings states that, *'British fliers were acutely nervous...of their American counterparts, who were prone to attack any aircraft in the sky that they could not immediately identify. RAF Typhoons found that being attacked by Mustangs or Thunderbolts was not an occasional freak, but an alarmingly regular occurrence.'*
Overlord (London: Michael Joseph, 1984), p.274.
Awareness of this problem no doubt influenced the planning for MARKET-GARDEN. That pilots of the Allied tactical air forces, which often cooperated, frequently made such errors suggests the havoc likely to have ensued if UK-based fighter squadrons, tasked with the protection of the airborne forces from German fighters, but unfamiliar with operating in the tactical area, had encountered unfamiliar continental-based tactical air force squadrons.
54. Powell, op.cit, p.209.
55. Bidwell & Graham, op.cit, pp.274, 275; RAF 2nd TAF Operations File and Reports, PRO AIR 37/615.
56. One of the first German units to confront the British airborne troops after they had landed near Arnhem was 16th SS Panzer Grenadier Depot and Reserve Battalion, commanded by *Sturmbannführer* (Major) Sepp Krafft. In his subsequent report, Krafft stated that, *'We knew from experience, that the only way to draw the teeth of an airborne landing with an inferior force, is to drive right into it.'* Krafft's account shows that at no time was the deployment and movement of his troops influenced by any threat of air attack. War Diary, SS Panzer Grenadier Depot and Reserve Battalion 16, *The Battle at Arnhem 17 Sep 44 - 7 Oct 44*, (Sturbannführer Sepp Krafft), translated copy, PRO AIR 20/2333.
57. Urquhart, op.cit., pp.205-206.
58. Powell, op.cit, p.209.
59. Headquarters British 21st Army Group Report (May 1945), *Air Support for Operations Plunder, Flashpoint, and Varsity*, Part III, *The Forward Control of Aircraft During "Plunder"/"Varsity"*, PRO AIR 40/313.
60. Ibid.
61. Ibid.

CHAPTER V.

ALLIED FIGHTER-BOMBERS VERSUS GERMAN ARMOURED FORCES: MYTHS AND REALITES.

Introduction.

A widely accepted historical view of the campaign in North-West Europe in 1944-45 is that Allied fighter-bombers inflicted heavy losses upon German armour. A former RAF Typhoon pilot has recorded that by August 1944 his squadron alone was credited with the destruction of 112 tanks and the damaging of a further 215; not surprisingly he suggests that the Typhoon '..was decisive in beating the panzers.'1

Yet an unquestioning acceptance of such levels of destruction by historians can distort perceptions of the effectiveness of fighter-bomber attack upon armour. This is because, in terms of numbers of tanks actually destroyed, the Allied fighter-bombers were far from being effective tank-killers. The most significant, large-scale, anti-armour operations conducted during the campaign by the Allied tactical air forces were each the subject of investigations carried out shortly afterwards by Allied Operational

Research Sections. Their battlefield examinations suggest that, while great destruction was inflicted upon German 'soft-skin' motor transport (MT) by air attack, the traditional image of fighter-bombers inflicting heavy losses upon German armoured columns, even under ideal attack conditions when the columns were caught vulnerable to air attack along the roads and unable to deploy, is open to revision.

There was a wide discrepancy between the level of armour destruction claimed by fighter-bomber pilots and the level of destruction that could be attributed to air action discovered on the ground. Often, high claims of tank 'kills' were made which could not be upheld, and the evidence suggests that even a heavy scale of fighter-bomber attack upon armour in the period 1944-45 was likely to result in only a low level of destruction.

This is not to suggest that such attacks were ineffective, but that their effectiveness should not be measured in terms of the amount of destruction alone. The contemporary operational research suggests it was not necessary for the fighter-bombers to achieve a large number of tank 'kills' - that the level of firepower that they were able to concentrate upon their targets and the consequent disruption and demoralization their particular form of attack could cause were often sufficient to obtain decisive

results. The object of this chapter is to determine what fighter-bomber attack upon armour actually achieved by examining in detail a number of case studies. First, some general points regarding the Allied use of aircraft against tanks.

I. AIRCRAFT VERSUS TANKS.

The Allied fighter-bombers of 1944-45 were not equipped with specially designed anti-armour munitions. However, possession of the 3-inch rocket ensured that the Typhoons of 2nd TAF gained the reputation of being the principal Allied 'tank-buster'. A major drawback with the rocket was its inaccuracy (see Chapter III), but it did not lack hitting power. Its ability to destroy or seriously damage even the heavier type of German tank was proven in a trial conducted by the RAF in 1944.

A Panther tank, captured intact in Normandy, was set up as a stationary target for two separate attacks each by four rocket-firing Typhoons. A total of 64 rockets were fired, the aircraft making steep dive attacks and releasing their rockets between 3,000 and 2,500 feet. On the first shoot of 32 rockets only one hit was obtained but this penetrated the tank's engine

cover and exploded inside, igniting the remains of oil and petrol. On the second shoot two hits were obtained - one rocket struck the side of the turret and exploded, the other struck the tank's gun barrel. These hits showed that the rocket could penetrate all but the frontal armour of the Panther hull or turret, the thickness of which was 80-100mm, but it was thought a hit on either of these points would render the tank inoperative by causing casualties to the crew, while a hit on the tracks would immobilise the tank. The rocket had no near-miss value, with blast and splinters of nearby ground strikes causing no damage.2

The trial, with only three hits scored on a stationary and easily identifiable target, emphasised how difficult it must have been for Typhoon pilots to hit individual tanks on the battlefield which were camouflaged, often protected by flak, and whose crews would have been seeking to get their tank under cover as soon as the aircraft appeared. Concentrations of tanks offered better targets, and against these the Typhoon pilots usually made vertical dives, releasing their rockets in salvo to saturate the area; their 20mm cannon ammunition was generally reserved for MT targets. When armoured columns were caught moving along a road, attempts were made to block the road and seal off any escape route by attacking the front and

rear of the column, thereby trapping those vehicles in between.3

Given its inaccuracy, the 3-inch rocket appears to have been a totally inadequate weapon for engaging tanks. Admittedly this was not the rocket's only or even primary role, but that it was the best the RAF had for the job in 1944-45 is nevertheless surprising, for despite its doctrinal opposition to aircraft intervening on the battlefield the RAF had earlier in the war acknowledged the need for air action against German armour and had employed a much more potent specific anti-tank weapons system.

In June 1942 Hurricane IID aircraft arrived in North Africa, nine of them becoming operational with No.6 Squadron. These Hurricanes were each fitted with two 40mm Vickers 'S' cannon guns in underwing fairings. That they were very effective against German armour was confirmed by German tank crewmen taken prisoner during the Gazala battles later in 1942. One told his British captors that the tank-busters *'..caused panic whenever they appeared'*, while another told of an occasion when twelve tanks had been attacked by them and six knocked out by cannon hits on their engines, ammunition stowage areas, or fuel tanks.4 Field Marshal Rommel certainly took them seriously; when illness compelled his return to Germany after the battle of Alam Halfa in September 1942 he took with

him a sample of the armour-piercing shells that the Hurricane IID's had been firing at his tanks, though his concern was ignored by the German High Command, including Reichsmarshal Göring.5

Despite their undoubted effectiveness, due largely to the accuracy of the cannon and the penetration capability of the 40mm rounds, the Hurricane IID's found little favour with the RAF. Only two units, No.6 and No.7 (South African Air Force) Squadrons were equipped with them but operations proved prohibitively expensive. The Hurricanes had to attack at low level, yet the weight of the cannon packs reduced speed and armour plate was sacrificed to compensate for this. The result was an aircraft perilously vulnerable to groundfire, and losses were high. After the second battle of Alamein in October 1942 losses were such that both squadrons were withdrawn but No.6 Squadron, with the remaining aircraft, reappeared in Tunisia in early 1943. Yet between March 21st and 25th 1943 the squadron lost 16 aircraft to groundfire, six of them on one mission on the 25th. Fortunately, due to the less hazardous nature of force-landing in desert conditions, pilot losses were not high, but in April the Squadron was withdrawn - it was the end of the Hurricane IID's operational service against German tanks.6

Thereafter British attention turned to the development of rockets, and no further tactical aircraft with a heavy cannon armament suitable for the anti-tank role appeared in the RAF. This was a cause of some regret in Army circles, but there could have been no question of employing such a vulnerable aircraft as the IID or any similar type in the flak-intensive environment anticipated, and encountered, in North-West Europe.

While the 3-inch rocket gave the RAF something specific to use against enemy tanks, in 1944/45 the Americans had to rely mainly upon the general purpose high explosive bombs and heavy machine guns of their fighter-bombers for attacking armour. Thunderbolt pilots generally employed a 45° attack dive against such targets, but dive-bombing or low-level bombing of individual tanks or even groups of armoured vehicles demanded a higher level of accuracy than could normally be expected with free-fall bombs. Strafing armoured vehicles with his six wing mounted .50 inch calibre machine guns offered the Thunderbolt pilot a greater chance of scoring hits. Yet, while this firepower could prove devastating to soft-skin or lightly armoured vehicles, especially when incendiary ammunition was used, its effect upon tanks was less certain. A former US fighter-bomber pilot observed that,

Just area spraying of medium tanks (such as German PzKw IVs) and heavy tanks (such as Panthers and Tigers) with 'fifties' might not even faze the things..

and described how pilots strafing tanks needed to hit them with the simultaneous fire of all their guns, aiming for vulnerable points such as engine louvres and air vents. When tanks were caught on a hard road surface, attempts were made to ricochet rounds up into the tanks' more lightly armoured bellies. 7

In July 1944 the first US P-47 squadron equipped with air-to-ground rockets became operational in Ninth Air Force, each P-47 carrying four 5-inch High Velocity Aircraft Rockets (HVAR) of a type originally developed by the California Institute of Technology for air-to-air combat. These were usually delivered in either low-level attacks, releasing the rockets at a range of 600-1,000 yards, or in a 30° dive in which the rockets were released at a range of 1,000 yards or over. By September this unit had flown 323 sorties and fired 1,117 rockets at ground targets, many of which had been German tanks for the squadron's claims included:

TABLE I P-47 SQUADRON CLAIMS.

	DESTROYED	DAMAGED	TOTALS
Tanks	85	29	114
Armoured Cars	15	1	16
Motor Vehicles	164	23	187

Although these P-47's carried only half the number of rockets carried by a Typhoon, and their pilots lacked the same degree of rocket training as their RAF counterparts, the unit was regarded as successful. A Ninth Air Force study reported that the rockets could be fired from longer range than the .50 calibre guns which reduced the danger from flak. They also had more penetration capability than bullets or the general purpose bombs that tended to break up on contact with targets, and they proved more accurate than dive-bombing.8 Despite this study, advocating further rocket use, the Ninth Air Force never employed rockets on a large scale.9

Later in the campaign, Ninth Air Force made increasing use of napalm fire bombs. Napalm could be effective against even heavy tanks, burning them out by very near misses as well as by direct hits, but its use against targets close to friendly troops involved considerable risk. Certainly in Normandy, it would appear Ninth Air Force felt the lack of an airborne anti-armour weapon of more precision that could be employed against German tanks in close proximity to friendly troops. On occasions when heavy concentrations of German armour were encountered by American forces, recourse was made to the RAF for rocket-Typhoons to operate in the American sector and engage them.

II. CASE STUDIES.

The Roncey Pocket

In the wake of the Allied breakout from Normandy, Operation COBRA which began on July 25th 1944, large German forces in the Cotentin peninsula were forced to risk air attack by moving in daylight to avoid being encircled by the American armour. Just South of Coutances, near Roncey, some six German divisions were cut off in what became known as the Roncey 'Pocket'. Choking the roads, the German columns became ideal targets for attacks by Allied fighter-bombers whose attacks succeeded in preventing any organised breakout. On the afternoon of July 29th P-47's of the American 405th Fighter Group observed this dense mass of German transport, including tanks, on the roads near Coutances and on the road between St. Denis le Vetu and Roncey they saw a column extending for over three miles blocked by American armour to the East and West. Between 15.10 and 21.40 the P-47's of the 405th Group systematically bombed and strafed this column, returning to their base to rearm and refuel before returning to the attack. Two days later American ground forces found the road impassable, and discovered 66 German tanks, 204 vehicles, and 11 guns

destroyed, and 56 tanks and 55 vehicles damaged. This destruction, though, was the result of the combined firepower of P-47's and the artillery and tanks of nearby American ground units.10

Some indication of the destruction caused specifically by air weapons is provided by an RAF anti-armour operation on the same day. Rocket Typhoons of 2nd TAF were requested by US forces to attack a concentration of some 50 German tanks observed in the Roncey area, near Gavray. Consequently Typhoons of No.121 Wing of No.83 Group flew 99 sorties in the area between late afternoon and dusk, and claimed the destruction of 17 tanks and a further 27 damaged. The pilots reported that there was little sign of life or movement during their attacks and the area was littered with damaged and burning tanks, making target selection difficult. There was no flak, and pilots were able to attack at very low level. Only one Typhoon was lost, hit by flying debris and forced to crash-land.11

The Typhoon effort had been concentrated mainly against a German column near the village of la Baleine, and shortly after the air attacks this area was investigated by the British Army's No.2 ORS. The column had been a formidable mix of armour and transport, including Panther tanks, and after

examining the tanks and vehicles the ORS outlined the causes of destruction, and this is shown in Table II:

TABLE II. LA BALEINE - LOSSES AND CAUSES. (12)

Destroyed By	Rockets	Possibly Rockets	Unknown Shells	Unknown Causes	Crew	Abandoned	Totals
Panthers	1	-	1	-	3	3	8
PZ Mk IV Special	1	-	-	-	-	-	1
Armoured Cars	-	1	-	-	-	-	1
Armd. troop carriers	5	-	-	-	-	-	5
75mm SP guns	-	-	-	1	-	1	2
50mm Anti-Tank Guns	-	-	-	-	1	1	2
Howitzers	-	1	-	-	-	1	2
Rocket launchers	-	-	-	-	-	1	1
Lorries	-	-	-	8	-	-	8
Cars	-	-	-	10	-	-	10
Totals:	7	2	1	19	4	7	40

The surrounding terrain was heavily wooded and dissected by deep, narrow, valleys and the column had used a side road which descended to la Baleine where a bridge crossed the river Sienne. On one side of this

road was a steep wooded cliff and on the other a sheer drop to the river; caught by fighter-bombers at this point the vehicles had been unable to pull off the road. P-47's had attacked the area with 500lb bombs before Typhoons had been called for, and the bridge over the river had been sufficiently damaged by their bombs to prevent heavy vehicles from crossing.

The motor transport was so mangled that identification of the cause of destruction was impossible and the ORS acknowledged their 'unknown causes' table to be unduly loaded. They suggested that a more accurate picture would be provided by the motor transport being spread over the table in the same proportion as the other losses. Although rockets appear as the biggest single known cause of destruction, the amount attributed to them is small compared to the relatively high number of Panthers destroyed by their crews or abandoned intact. How they had been left suggested abandonment in haste, almost certainly as a result of air attack or the threat of such attack, and possibly even before the arrival of the Typhoons. Craters of 500lb bombs were found in an orchard within 50 yards of two Panthers; neither tank had been hit but the crews obviously baled out and later set fire to the tanks, one of the guns being destroyed by a high-explosive round left in the chamber.

Although lack of fuel in a retreat could be expected to result in the abandonment or destruction of tanks by their crews, this was not the case at la Baleine - near similar bomb craters two Panthers were found completely undamaged, their fighting ability unimpaired with full complements of petrol and ammunition. One of the 75mm self-propelled guns, its armour reinforced with concrete, was found abandoned undamaged 35 yards from a bomb crater; as it had not been set on fire by its crew it was considered more likely to have been abandoned in haste rather than left as a deliberate roadblock.

Possibly the tanks had been abandoned or destroyed by their crews because they could not negotiate the damaged bridge. The ORS noted that the German crews could have forded the river further downstream, as American Sherman tanks later succeeded in doing, but this ignores the fact that in their hurry to escape encirclement the Germans probably had little time to reconnoitre the area. That all the troop carriers discovered had been destroyed by rockets suggests the possibility that other similar types may have escaped over the bridge, not needing to be abandoned like the heavier tanks. At la Baleine the most significant evidence of demoralisation was that there were no German graves. Only one German corpse was found and local civilians, many of whom were interviewed,

confirmed that it was of a sniper killed after the air attacks, while no evidence could be found that American forces had removed bodies for burial. This suggests that the German troops may have dispersed from the column when it became obvious air attack was imminent, which squares with the Typhoon pilots observing little German activity during their attacks.

La Baleine was the first ORS investigation of its type, and certainly reflects the shortcomings of air-to-ground weapons against tanks. Despite the craters none of the tanks or self-propelled guns had been knocked out by bombs, and the number destroyed by rockets is unimpressive. Nevertheless, there was a good deal of evidence discovered by the ORS at la Baleine to suggest that air attack was responsible, even if indirectly, for the disruption and abandonment of the column, and that the German crews preferred to abandon or destroy their armour rather than invite further air attack by attempting to salvage combat-worthy tanks.13

The Mortain Offensive.

Similar evidence of German tanks being abandoned under air attack is seen in the example of the only large-scale German armoured offensive mounted in Normandy. Early on the morning of 7th August 1944, the strike

force of XLVII Panzer Corps, the 1st SS, 2nd SS, and 2nd Panzer divisions, attacked positions held by the US 30th and 9th Infantry divisions near Mortain with the ultimate objective of reaching the Cotentin coast at Avranches and cutting off American armoured spearheads from their supplies. Although tank strength was depleted after weeks of heavy fighting the Germans mustered 70 Panthers, 75 Mk IVs, and 32 self-propelled guns for the attack.14 By noon on 7th August they were within nine miles of Avranches after penetrating the front of 30th Division to a depth of about three miles. Having arrived in Mortain only the day before, 30th Division had nothing but its 57mm towed anti-tank guns and 3-inch gun tank destroyers with which to engage the German tanks at close range. Despite its determined defence, the credit for bringing the German attack to a decisive halt on the afternoon of 7th August is generally regarded as belonging to Allied fighter-bombers, particularly the RAF Typhoons, which were called to intervene.

The response of the Allied tactical air forces to the German attack was swift. The Typhoons of No.83 Group RAF were made available, and plans co-ordinated directly between the headquarters of No.83 Group and IX Tactical Air Command. Rocket Typhoons were to engage the German tanks, while American fighter-bombers were to attack transport moving to and from

the battle area. The Ninth Air Force was also to provide a fighter screen to intercept German aircraft, a vital task as the *Luftwaffe* had planned to make an all-out effort to support the attack with some 300 planes.15 The German command had relied upon fog, prevalent on previous days and which had been forecast for 7th August, to protect their armoured spearheads from air observation and attack, but at about 11 am that day the fog over the battle area began to clear.

At about midday the first Typhoons took off for the American sector from their advanced landing grounds, and went into action just before 1 pm against a concentration of some 60 tanks and 200 vehicles observed along a hedge-lined road near Mortain. The tanks, some heavily camouflaged, were grouped closely together as if unprepared for the rapid lifting of the fog.16 After overflying at low level to confirm them as German, the Typhoons commenced dive attacks upon the front and rear of the column, which was immediately brought to a halt. The pilots observed that their attacks caused great confusion, and saw German tank crews baling out and running for cover regardless of whether or not their tanks were left blocking the road.17 Also at this time the first American fighter-bombers arrived in the area, with P-47's, including the squadron equipped with rockets, attacking German transport.18

The weather remained clear and between 2 pm and 8 pm flights of five or six Typhoons were taking off roughly every 20 minutes to attack, returning to refuel and rearm before setting off again for Mortain. As the afternoon wore on the pilots found the task of locating the German tanks increasingly difficult due to their dispersion and to clouds of dust and smoke in the battle area, but the forward movement of the German attack had been halted. By the end of the day No.83 Group had flown 294 sorties and IX Tactical Air Command 200 sorties in the Mortain area. Three Typhoons and pilots had been lost. Though the level of flak had initially been light, it had increased during the day with box-like patterns being put up over the tanks, and many of the Typhoons were found to have suffered damage from this and small-arms fire.19

German accounts clearly attribute the failure of their attack on 7th August to the fighter-bombers. The commander of 2nd Panzer Division, von Luttwitz, later recalled that his tanks had made a swift advance of about ten miles when suddenly the fighter-bombers appeared:

> *They came in hundreds, firing their rockets at the concentrated tanks and vehicles. We could do nothing against them and we could make no further progress.*20

Hans Speidel, then the Chief of Staff of the German

Army Group B, later wrote of Mortain that,

> *..it was possible for the Allied air forces alone to wreck this Panzer operation with the help of a well co-ordinated ground-to-air communications system.*21

The German troops received no air support on 7th August - their aircraft attempting to reach the battle area were intercepted by strong American fighter patrols and none reached within 40 miles of Mortain.22 Although fighting continued in the area for several days, with Mortain being recaptured by American forces on 12th August, the Germans made no further attempt to reach Avranches after 7th August. Typhoons took no part in the battle after that date, with responsibility for air support reverting to the IX Tactical Air Command. The claims made by the Allied fighter-bomber pilots for the period 7th-10th August are impressive, and are shown in Table III below.

TABLE III. ALLIED FIGHTER-BOMBER CLAIMS 7th-10th AUGUST 1944.

ARMOUR	Destroyed	Probably Destroyed	Damaged	Total
2nd TAF	84	35	21	140
9th AF	69	8	35	112
MOTOR TRANSPORT				
2nd TAF	54	19	39	112
9th AF	94	1	21	116

Yet these claims are misleading and cannot be substantiated. During 12th-20th August the Mortain battle area was examined by two separate British ORS teams; No.2 ORS and ORS 2nd TAF. No German vehicles were missed by the investigation as the area was not extensive; moreover the area was examined from an observation aircraft at low level with no further vehicles discovered. The destruction attributed to various weapons can be tabulated as shown in Table IV, which is a compilation of both the RAF and Army reports. This shows that a total of only forty-six German tanks and self-propelled guns were actually found in the battle area, and of these only nine were considered to have been destroyed by air weapons.

It was not possible to discriminate between victims of British and American aircraft as the latter had also fired some 600 rockets. Many of the 'unknown causes' were found some distance from any sign of air attack - such as cannon and machine gun strikes on the ground and rocket or bomb craters - and could not be considered as possible air victims. An obvious question is whether the Germans had been able to recover any of their tanks. The presence of a German tank recovery vehicle would seem to confirm they had but, while it is likely that some tanks were recovered, this can hardly be an adequate explanation

TABLE IV. DESTRUCTION ATTRIBUTED TO VARIOUS WEAPONS, MORTAIN AREA, AUGUST 1944.

TYPE	DESTROYED BY							
	Rockets	Cannon/MG	Bomb	Abandoned intact	Crew	US Army	Unknown	Total
Panther	5	-	1	6	4	14	3	33
Mk IV	2	-	1	1	-	5	1	10
SP Guns	-	-	-	-	-	1	2	3
Armd Troop Carriers	7	4	-	1	-	3	8	23
Armd Cars	1	-	-	1	-	5	1	8
Armd recov. veh.	-	-	-	-	-	1	-	1
88mm Guns	-	-	-	-	-	1	1	2
75mm Guns	-	-	-	-	-	1	-	1
50mm Guns	-	-	-	1	-	-	-	1
Cars	2	2	-	-	-	4	3	11
Lorries	-	6	-	1	1	2	20	30
Ambulances	-	2	-	2	-	-	1	5
Motor Cycles	-	-	-	1	-	1	2	4
Totals	17	14	2	14	5	38	42	132

for the discrepancy between air claims and the destruction found. Armoured and motor vehicles destroyed by air weapons were invariably burnt out, and for recovery purposes damaged and abandoned vehicles had priority over such. German prisoners,

many of whom were questioned on this subject, consistently stated that burnt out tanks were never salvaged.23 In effect, a tank hit by a rocket or bomb was not worth recovering and the ORS should have found what was left of it.

Another question is whether German accounts of the fighting can shed more light on the number of tanks and vehicles destroyed by air attack. The histories of the German divisions that fought at Mortain, compiled post-war, stress how decisive the intervention of the fighter-bombers had been, but are ambiguous with regard to the question of losses. That of the 2nd Panzer Division states of the Typhoons that they,

> *...maintained an almost impossible accuracy and had succeeded in knocking out even the most powerful tanks.*

However, the number of tanks actually lost in this way is not given.24 The history of the 1st SS Panzer Division (*Leibstandarte Adolf Hitler*) is similarly unclear as to the the actual number of tanks knocked out from the air, though it implies that the number was considerable and quotes the following description of the air attacks by a panzer grenadier:

> *The fighter-bombers circle above our tanks. Then one breaks out of the circle, seeks out its prey and the rockets zoom into their target. While the first one rejoins the circle of about 20 aircraft, the next breaks away and fires. So it goes on, until they have all fired and leave the stage of horror..*

> *..Everywhere there rise black oil clouds, which indicate the corpses of tanks. There are dozens of smoke clouds in our area alone. Finally, the Typhoons find no more tank targets, they dive on us and hunt us mercilessly.*25

Also quoted is an account by a panzer grenadier officer who, after describing how a fighter-bomber shot down by flak crashed onto a tank and put it out of action, adds that,

> *..most of the other tanks and armoured personnel carriers also fell victim to these extremely intense, hour-long low-flying attacks.*26

Yet such German accounts attributing heavy tank and vehicle losses to air attack are misleading. They take little cognizance of the losses inflicted by US ground forces which, though almost certainly overestimated at the time in the confusion of battle, were none the less considerable. American accounts of the fighting indicate that, on August 7th, the forward troops of the US 30th and 9th Divisions claimed the destruction of at least eighteen German tanks, fourteen of them by the 30th Division's attached 823rd Tank Destoyer Battalion alone.27 Moreover, the ORS confirmed that US troops accounted for more heavy German armour than the fighter-bombers, the destruction of twenty of the total of forty-six tanks and SP guns found being attributed to US ground weapons.

The principal reason why such German accounts should be regarded with caution, however, is that they provide no explanation as to what had become of the tanks and vehicles destroyed by the fighter-bombers by the time the ORS examined the battle area. Nor do they explain the not inconsiderable number of tanks found abandoned or destroyed by their own crews. To some extent, German attribution of tank losses to air attack may stem from the confusion of battle, but it may also suggest both a reluctance to acknowledge the morale effect of such attack, and a desire to ascribe the halting of the armoured thrust, which was much in the nature of a forlorn hope, to Allied air power rather than to defeat at the hands of US ground forces.28

Despite the toll taken of the German armour by US ground weapons, the commanders of the US units engaged on August 7th later confirmed that it was the fighter-bombers that brought the German thrust to a halt. At the time of the ground survey, a member of ORS 2nd TAF visited the headquarters of the US 9th Division's 39th Infantry Regiment. He was told by the Commander how the German attack had cut off part of his regiment from its headquarters and how his anti-tank guns had been insufficient to halt such a large number of tanks. He also told how he had remained *'vulnerable and anxious'* until Typhoons arrived to attack the

German spearhead. A visit was also made to the the Commander of the 30th Division's 117th Infantry Regiment, which had been in the path of the 2nd Panzer and 1st SS Panzer Divisions on August 7th. He recalled that when the mist lifted at about 1230,

> *Thunderbolt aircraft and Typhoon aircraft came in immediately and attacked. Typhoons attacked for what seemed to him to be about two hours. This, added to the resistance of the ground forces, stopped the thrust.*29

Such appreciation of the close air support on 7th August is significant in view of the tendency of Allied aircraft to attack friendly positions inadvertently in what was a very fluid ground battle. The US 30th Division recorded that the Typhoons and P-47's often attacked its positions, the 120th Regiment alone receiving ten such attacks during the day.30

Given the lack of tank destruction by air weapons, the undoubted effectiveness of the sustained fighter-bomber assault on 7th August must have been largely the result of completely disrupting the German attack by compelling tanks to seek cover or their crews to abandon them. The level of destruction attributed to air weapons by the ORS is too insignificant to have been decisive, and even if the unknown causes for both armour and motor transport were added to the air totals the number would only be a quarter of those claimed. Yet no fewer than ten of the 33 Panthers

found, or 30 per cent, had been abandoned or destroyed by their own crews. This was an important discovery at the time, and a contemporary RAF tactical study stressing the demoralising effect of the 3-inch rocket projectile - or RP as it was generally called - offered this explanation for the German abandonment of tanks and vehicles at Mortain:

> *Interrogation of prisoners has shown without question that German tank crews are extremely frightened of attacks by RP...Crews are very aware that if an RP does hit a tank, their chance of survival is small. It is admitted that the chances of a direct hit are slight; nevertheless, this would hardly be appreciated by a crew whose first thought would be of the disastrous results if a hit was obtained.*31

Prisoner of war data further confirmed the demoralising effect of air attack upon tank crews. German tank crewmen questioned for the later joint RAF/British Army study of Typhoon effectiveness indicated an irrational compulsion among inexperienced men to leave the relative safety of their tank and seek alternative cover during air attack:

> *The experienced crews stated that when attacked from the air they remained in their tanks which had no more than superficial damage (cannon strikes or near misses from bombs). They had great difficulty in preventing the inexperienced men from baling out when our aircraft attacked.*32

It is certainly plausible that tank crews under a heavy scale of air attack would be induced to bale out, despite the interior of the tank being possibly the safest place to be, and in this way the bombs and

rockets did not need to strike the tanks to be effective. When asked for an opinion by the ORS on the number of abandoned tanks in the Mortain battle area, an experienced NCO of a US anti-tank unit replied,

> *'There is nothing but air attack that would make a crack Panzer crew do that.'*33

The German Retreat to the River Seine.

The retreat of the German army towards the River Seine in order to escape encirclement in the Falaise 'Pocket' in August 1944 provided the Allied tactical air forces with an abundance of targets, and great claims of destruction were made. On 18th August RAF 2nd TAF alone claimed 1,159 vehicles destroyed and 1,700 damaged together with 124 tanks destroyed and 100 damaged.34 On the same day the Ninth Air Force claimed 400 vehicles destroyed.35 The total number of sorties flown during the period of the German retreat and the claims made are shown in Table V.

TABLE V. SORTIES & CLAIMS: FALAISE 'POCKET' AUGUST 1944. (36)

	2 TAF	9th AF	Total
Sorties	9896	2891	12787
Claims for MT destroyed	3340	2520	5860
Claims for armour destroyed	257	134	391
Total claims	3597	2654	6251
Claims per sortie	0,36	0,83	0,49

Shortly after the 'Pocket' had been closed No.2 ORS conducted an extensive investigation in the area to determine the German losses caused by air attack and the effectiveness of air-to-ground weapons.37 The principal roads taken by the Germans were patrolled in three areas; the 'Pocket' itself around Falaise, the area at the mouth of the pocket near Chambois and referred to as the 'Shambles', and the area known as the 'Chase' which led to the Seine crossings. In the 'Pocket' the destruction of armoured and motor vehicles was attributed as in Table VI. The effectiveness of cannon and machine-guns against soft-skin vehicles is apparent. Also apparent is the number of tanks and armoured vehicles abandoned or destroyed by their crews, some 75% of the total:

TABLE VI. GERMAN ARMOURED & MOTOR VEHICLE LOSSES IN FALAISE 'POCKET' AREA.

TYPE	Rockets	Bombs	Cannon/MG	"Air" total	Abandoned/destroyed by crew	Total
Tanks, SP guns & AFVs:	11	4	18	33	100	133
Lorries, cars & motor cycles:	4	43	278	325	376	701
Guns:	-	-	1	1	50	51
Totals:	15	47	297	359	526	885
Percentages:	1.7	5.3	33.5	40.5	59.5	

The large number of armoured and motor vehicles abandoned or destroyed by their crews is hardly surprising in such a retreat, and it was thought many of those destroyed by air weapons had already been abandoned. Air attack, though, was considered responsible for much of the abandonment as a result of causing disorganisation; moreover, destroyed vehicles had completely blocked roads. Cannon and machine gun attacks had proved to be extremely effective against the densely-packed motor transport. Such vehicles hit by cannon or machine gun rounds were invariably burnt out and the report notes that it was,

> *..almost a rule that where pock marks of strikes appeared in the roads, there a burnt vehicle was to be found.*38

In the 'Shambles' so many German vehicles were found that it was impossible to examine each in detail; they were classed either as burnt or unburnt as an indication of whether they had been hit by air weapons or abandoned. A total of 3,043 tanks, vehicles, and guns was found, initially classified by the ORS as in Table VII:

TABLE VII. GERMAN ARMOURED & MOTOR VEHICLE LOSSES, 'SHAMBLES' AREA.

	Tanks/SP guns	Lightly armd. AFVs	Lorries	Cars	Guns
Burnt;	112	64	1011	224	-
Unburnt;	75	93	767	445	-
Totals;	187	157	1778	669	252

Of the 187 tanks and SP guns found, 82 were examined in detail and the destruction attributed as in Table VIII below:

TABLE VIII. GERMAN ARMOUR LOSSES IN THE 'SHAMBLES' AREA

TYPE	Armour-piercing shot (Allied ground fire)	Rockets	Crew	Abandoned	Unknown cause	Total
Tiger	-	-	9	3	-	12
Panther	3	-	8	11	-	22
Mk IV	2	2	12	6	-	22
Mk III	2	-	1	1	1	5
SP Guns	1	-	8	12	-	21
Totals:	8	2	38	33	1	82

The 38 tanks and SP guns destroyed by their crews had all been set on fire, and it was thought the majority of those tanks and SP guns that were burnt had been destroyed in this way and those unburnt abandoned. There was no evidence - such as rocket craters - to suggest that any appreciable number of those burnt tanks and SP guns not examined had been destroyed by air weapons.

A sample of 330 of the lorries and cars, and 31 of the lightly armoured vehicles, found in the 'Shambles' were also examined in detail with the result shown in Table IX. The effectiveness of strafing against soft-skin and light armoured vehicles was confirmed, this being the greatest known cause of destruction, but the

highest totals in both cases were the number found abandoned intact:

TABLE IX. CAUSES OF LOSS OF LORRIES & LIGHT ARMOUR, 'SHAMBLES' AREA.

	Cannon/MG Fire	Rockets	Bombs	Shellfire	Crew	Unknown Cause	Abandoned Intact	Mines or Accident	Total
Lorries & Cars	99	2	9	15	7	52	135	11	330
Light AFV's	5	1	-	2	3	7	13	-	31

The 'Chase' area yielded a count of 3,648 vehicles and guns as shown in Table X:

TABLE X. GERMAN LOSSES IN THE 'CHASE' AREA.

	Tanks/SP Guns	Lightly armd. vehicles	Lorries/Cars/Motor Cycles	Guns
Burnt;	114	115	2275	-
Unburnt;	36	39	903	-
Totals;	150	154	3178	166

The ORS were unable to cover every road in such an extensive area, so the absolute number of vehicles and guns was unknown but thought to be less than twice that recorded. Of the 150 tanks and self-propelled guns 98 were examined. None were found to have been destroyed by rockets, nor were there any craters to

suggest rocket attacks had been made in the area. Most, amounting to some 81 per cent, had been destroyed by their crews or abandoned:

TABLE XI. GERMAN ARMOURED LOSSES IN 'CHASE' AREA.

TYPE	Armour-Piercing Shot	Crew	Abandoned	Other/Unknown Cause	Total
Tiger	-	7	4	-	11
Panther	2	23	1	2	28
Mk IV	3	16	7	2	28
Other Tanks	-	-	2	1	3
SP Guns	3	9	12	4	28
Totals:	8	55	26	9	98

To allow for the possibility of German vehicles and guns being missed in wooded terrain or along unchecked roads, No.2 ORS estimated that the Germans had lost some 10,000 vehicles and guns during the retreat, a figure not thought to be in error by more than 2,000 either way. This was broken down as 1,500 in the 'Pocket' area, 3,500 in the 'Shambles', and 5,000 in the 'Chase'. As it was estimated that the Germans must have had a total of some 30,000 vehicles it was considered that two thirds, including about 250 tanks and SP guns, had escaped across the Seine.39 This was regarded as the result of the air forces attempting

general destruction rather than trying to achieve interdiction by attacking key 'choke' points, a charge strongly refuted by 2nd TAF as taking no account of weather, flak levels, or bomb-lines set by friendly ground forces.40 In fact No.2 ORS overestimated the number of German tanks that had escaped, as on 22nd-23rd August the German Army Group B, reporting on the state of its eight surviving Panzer divisions, listed only some 72 tanks.41

The retreat to the Seine clearly reveals the limitations of Allied air-to-ground weapons against tanks, particularly the 3-inch rocket. Only ten out of 301 tanks and SP guns examined, and three out of 87 armoured troop carriers examined, were found to have been destroyed by this weapon - these figures must be compared with the 222 claims of armour destruction made by Typhoon pilots alone. In contrast is the marked effectiveness of cannon and machine guns, and to a lesser extent bombs, against soft-skin transport vehicles. By destroying large numbers of these, thus blocking roads and increasing congestion, the fighter-bombers indirectly caused the abandonement of many tanks.

Moreover, many of the tanks and SP guns were found abandoned without petrol, not least because trucks carrying their fuel had been shot up from the air. German prisoners described how the threat of air

attack restricted movement to the hours of darkness until congestion and haste compelled movement by day; they also told how whenever aircraft appeared crews stopped to take cover and vehicles were driven off the main roads into side roads which in turn became blocked.42 In effect, the almost continuous fighter-bomber attacks in daylight, within a restricted area upon retreating troops, caused a great deal of demoralisation and delay which prevented many tanks and vehicles escaping.

The Ardennes Offensive.

The influence of Allied tactical air power upon German ability to carry out large-scale armoured operations was such that the timing of the German Ardennes offensive was dictated by the occurrence of bad weather. In the early stages of the offensive, which began on 16th December 1944, fog and low cloud protected the tank spearheads from aerial observation and attack. But when the weather cleared Allied fighter-bomber pilots were presented with targets such as they had not seen since Normandy and, as in Normandy, they made large claims for the destruction of armour. Between 17th December 1944 and 16th January 1945 the IX and XIX Tactical Air Commands of Ninth Air Force and RAF 2nd TAF claimed a total of 413 German

armoured vehicles destroyed in the Ardennes salient, 324 of which were claimed as tanks. In early January No.2 ORS began an investigation of these claims, in the middle of the month they were joined by an ORS from 2nd TAF and a joint report was produced. 43

Although hampered by thick snow which prevented the discovery of rocket craters and burnt patches caused by napalm bombs, the ORS were able to examine 101 armoured vehicles - the practice being to search an area within 2-3 kilometres of each claim. The claims for destruction within the salient are shown in Table XII:

TABLE XII. ALLIED AIR CLAIMS FOR GERMAN ARMOUR DESTROYED IN THE ARDENNES SALIENT.

	IN AREA EXAMINED BY ORS			IN WHOLE SALIENT		
	Tanks	Armd. Vehicles	Total	Tanks	Armd. Vehicles	Total
IX TAC	62	23	85	140	69	209
XIX TAC	2	0	2	176	19	195
2nd TAF	2	1	3	8	1	9
Totals	66	24	90	324	89	413

The air weapons used were general purpose high-explosive bombs, fragmentation bombs, napalm fire bombs, and rockets. Many of the tanks claimed by Ninth Air Force had also been engaged by machine guns, some only by this means. The breakdown of weapons used was:

TABLE XIII. WEAPONS USED BY AIR FORCES, ARDENNES OFFENSIVE.

	BOMBS			ROCKETS
	General-Purpose	Fragmentation	Napalm	
IX TAC	1110	34	54	98
XIX TAC	530	132	111	134
2nd TAF	-	-	-	340
Totals	1640	166	165	572

For the 101 tanks and armoured vehicles examined, damage was attributed as in Table IV:

TABLE IV. ATTRIBUTABLE DAMAGE TO SAMPLE OF 101 TANKS & ARMOURED VEHICLES, ARDENNES SALIENT.

AIR:	Tiger II	Panther	Mk IV	SP Gun	Light Armour	Total
Bomb	1	-	-	-	-	1
Possibly air attack	-	3	-	2*	1	6*
GROUND:						
Armour-Piercing Shot	1	16	1	10*	8	36*
High-Explosive Shell	-	3	-	1	4	8
Demolition	2	10	1	-	4	17
Abandoned	1	10	-	4	7	22
Other Cause	-	-	1	1	-	2
Unknown Cause	-	5	2	1	2	10
TOTAL:	5	47	5	18	26	101

* One SP Gun had armour-piercing penetrations and also a possible rocket strike so was included under both counts.

Considering that this represents the investigation of claims for the destruction of 66 tanks and 24 armoured vehicles the effect of air attack seems unimpressive; a maximum of seven out of 101 vehicles examined, some six per cent. It was found that fighter-bomber attack had also involved some wastage, with bombs dropped among tanks already knocked out by American troops, and it is revealing that even when these bombs landed within 15 yards of the tanks no additional damage was done.44 Not surprisingly, the report concluded that, while the contribution of the air forces to stemming the German offensive had been considerable, this,

..was not by the direct destruction of armour, which appears to have been insignificant; but rather by the strafing and bombing of supply routes, which prevented essential supplies from reaching the front.45

CONCLUSION.

While the lack of destruction of armour in these examples from Normandy and the Ardennes may be explained by the shortcomings of the air-to-ground weapons employed, something must also be said about the high number of claims made by the air forces. This was almost certainly the result of the difficulties

experienced by pilots engaged in the ground attack role. One reason is that pilots were very likely to misinterpret the results of their attacks. Flashes from exploding cannon shells, ricochet sparks, and smoke emitted from the exhausts of revving tanks could all be mistaken for evidence of tank kills.[45] A former Typhoon pilot, describing an attack on a German column in the Falaise 'Pocket', writes that,

> *..within seconds the whole stretch of road was bursting and blazing under streams of rocket and cannon fire.*[46]

Such conditions could not have made accurate damage assessment very easy, and pilots regularly reported their claims as 'smokers' or 'flamers' - it seems fair to assume that much of the smoke and flame was not actually the result of tanks being hit. There was also the problem of accurate target identification by pilots hurtling at low level over a mass of vehicles obscured by smoke and flames. Under such conditions all types of armoured vehicles, and perhaps even some soft-skin vehicles, could be mistaken for tanks. In the snows of the Ardennes it was found that even small buildings such as huts which stood out against the white background could be mistaken by pilots for tanks and vehicles.[47] Moreover, what constituted a tank was often loosely defined by pilots, as a former American fighter-bomber pilot admitted:

> *In our reports of attacking tanks, we were probably actually attacking more assault guns, armored*

*artillery, and tank destroyers than tanks, but from a pilot's view they usually were all identified as tanks.*48

Another most important reason for the number of claims was duplication. Unless a tank or armoured vehicle was burning, smoking, or an obvious wreck, pilots had no way of knowing whether it had been the target of a previous attack. When conducting its ground survey of the Falaise area, No.2 ORS discovered an armoured troop carrier abandoned in a particularly prominent position and were told by local civilians it had been the target of twelve separate strafing attacks; it very likely figured in twelve separate claims.

As regards the reliability of the ORS ground surveys, one may wonder if tanks attributed to destruction by ground weapons had in fact been knocked out by aircraft and subsequently used as target practice by Allied troops. However, such mistakes were very unlikely. Bombs and rockets were hardly ever, if at all, used singly, and near vehicles destroyed by such weapons were always found the craters of near misses. Moreover, rocket craters were distinctive, oval in shape and usually with part of the rocket tube or fins in or near them. Parts of the rocket were also often found in tanks or vehicles destroyed by the weapon. In or near tanks and vehicles destroyed by their crews were often found the metal cases that had

contained German demolition charges, these being placed in a specific part of the tank, such as under engine hatches. Pock marks on roads or holes roughly six inched in diameter in the ground indicated machine gun or cannon attacks, and tanks and vehicles that had been strafed bore holes or dents on upper surfaces. It is possible that tanks abandoned intact were subsequently used for target practice, and attributed to a particular ground weapon, but this has little relevance to the effectiveness of air weapons.[49]

The ORS investigations help to set the achievements of the Allied fighter-bombers into perspective. By attacking soft-skin supply vehicles they were able to choke the arteries feeding fuel and ammunition to the Panzer divisions and, although their weapons were inadequate for engaging tanks directly, their rockets and bombs could strike at a more vulnerable part of a tank than its armour plate - the morale and will to fight of its crew. At Falaise the fighter-bombers proved a tank is so much scrap without fuel or ammunition, or if abandoned along a hopelessly blocked road. At Mortain, in an example of rapidly concentrated aerial firepower, the fighter-bombers proved a tank to be equally useless in battle even if fully armed and fuelled if its crew were sheltering in a ditch, or desperately trying to get the tank into cover, as a result of air attack.

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In December 1943 Hurricane IID's began ground attack operations in the Far East with No.20 Squadron. They were successful in this less hazardous environment, though few Japanese tanks were encountered. However, during the siege of Imphal in June 1944 a detachment of the Squadron engaged twelve Japanese tanks and destroyed them all, losing one aircraft. On February 19th 1945 thirteen Japanese heavy, medium and light tanks were caught and destroyed by the Squadron in the village of Paunggadaw - as British troops later confirmed. The effectiveness of the Hurricane IID against Japanese armour is outlined in RAF ORS (Air Command South East Asia) Report, *Air Firing Trials Against Captured Japanese Tanks at Thinunggei* (August 1944), PRO AIR 37/1236.

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CHAPTER VI.

HEAVY AND MEDIUM BOMBERS IN THE CLOSE SUPPORT ROLE.

Introduction.

In March 1944 General Eisenhower, as Supreme Allied Commander, obtained direction of the Allied heavy bomber forces, RAF Bomber Command and the US Eighth Air Force, for Operation OVERLORD. He later recalled that

> *We had no intention of using the Strategic Air Forces as a mere adjunct to the Tactical Air Command.*

But he also recalled that, by the time of the breakout by the Allied armies from the Normandy beachhead in late July 1944,

> *...the emergency intervention of the entire bomber force in the land battle had come to be accepted almost as a matter of course.*[1]

Little critical analysis has been accorded to this diversion of the Allied heavy bomber forces from the strategic air campaign against Germany in World War II. Yet their employment against battlefield targets in close proximity to friendly ground forces was the most audacious form of air support provided for Allied

troops in the Mediterranean and in North-West Europe, and also the most controversial. Equipped and trained for the bombing of large area targets by night or, in the USAAF case, for the mass bombing of strategic targets in daylight, the heavy bombers had become committed to providing tactical close air support, the antithesis of their intended role. In Normandy they supported no less than six major attacks by Allied troops, and later supported operations to clear the Channel Ports, to clear the Scheldt Estuary, to cross the Rhine, and to breach the Siegfried Line.

This was not without determined opposition from senior airmen and, before examining the effectiveness of close support bombing, it is necessary to sketch briefly the strategic commitments of the heavy bomber forces and the command set-up whereby they could be called upon to operate in the tactical role.

The Combined Chiefs of Staff directive of March 1944 gave Eisenhower 'strategic direction' of the heavy bomber forces, not outright command. Both RAF Bomber Command, commanded by Air Chief Marshal Sir Arthur Harris, and the United States Strategic Air Forces in Europe (USSTAF) commanded by Lieutenant-General Carl Spaatz, who also had operational control over the heavy bombers of the US Fifteenth Air Force in Italy, remained effectively independent. Eisenhower's principal link with these Headquarters was his

deputy, Air Chief Marshal Sir Arthur Tedder. While Tedder could represent Eisenhower's wishes with respect to the employment of the strategic forces, he was not an overall air commander and firmly rejected the notion that he was an 'Air Commander in Chief'.2

In fact there was no such post, nor was there an overall air headquarters to control and co-ordinate the tactical and strategic air forces. The two Allied tactical air forces supporting OVERLORD, the US Ninth commanded by Major-General Lewis Brereton and Air Marshal Sir Arthur Coningham's 2nd TAF, were under the direction of Air Chief Marshal Sir Trafford Leigh-Mallory's Allied Expeditionary Air Force (AEAF) Headquarters. Leigh-Mallory could meet demands for air support from their resources, but had no authority over the strategic air forces and his requests for their support had in practice to be endorsed by Tedder.3

Thus no effective command machinery existed for employing the strategic forces in tactical operations and, while both Harris and Spaatz were obliged to support OVERLORD, neither wished to see their forces diverted from what they saw as their decisive bombing offensives against Germany. An earlier Combined Chiefs of Staff directive, POINTBLANK, issued in June 1943, had given them the priority task of attacking the Luftwaffe and those industries supporting it. This

campaign was waged by the Americans with conviction, while Harris paid lip-service to the directive while continuing his attacks on major German cities.4 Both Harris and Spaatz believed that bombing by itself could defeat Germany, and that the landing of Allied armies on the Continent was unnecessary. Both had unsuccessfully resisted any subordination of their forces to Eisenhower for operations in support of OVERLORD.5

In April and May 1944 RAF Bomber Command was increasingly committed to attacking communications targets in France and the Low Countries as part of the 'Transport Plan' to sever communications to the projected OVERLORD battle area. The US Eighth Air Force was involved on a lesser scale as its daylight offensive against the Luftwaffe was maintained. Moreover, by this time the Americans believed that they had found the critical target upon which to concentrate the bomber offensive - Germany's synthetic oil plants. Spaatz's staff had prepared plans for their systematic destruction, and in April Eisenhower sanctioned experimental attacks. With the Allied armies established in France the attacks on oil refineries gathered pace, and as early as June 8th Spaatz informed the Eighth and Fifteenth Air Forces that their primary strategic aim was the denial of Germany's oil supplies. Bomber Command too was

committed to this task, with the ten synthetic oil plants in the Ruhr being given as targets.6

While the airmen prepared to resume their strategic offensives after the OVERLORD aberration, the soldiers had been thinking on very different lines. Montgomery's Chief of Staff, Major-General Sir Francis De Guingand, later recalled that in early 1944 the Army in England preparing for OVERLORD was giving *'a great deal of thought'* to the subject of how the heavy bombers could be used in close support:

> *We fully appreciated the primary rôle of the strategic air forces, but nevertheless we considered that we should on occasions harness their great power to the immediate support of the land battle.7*

A study was made of the problems involved, and two senior soldiers at the War Office, General Rowell, the Director of Tactical Investigation, and General Crawford, Director of Air, were involved in discussions with the Air Ministry. They met with little enthusiasm, but it is interesting that well before D-Day the Army was considering such questions as accuracy, levels of destruction, appropriate bomb fuses, safety precautions, and the risks of craters causing obstruction to friendly troops.8

In Italy, heavy bombers had already appeared over the battlefield in direct support of Allied troops. On February 15th, in support of an attack by 4th Indian Division, they had reduced the Monastery at Monte

Cassino. Their assistance had been requested again and on March 15th, in close support of New Zealand troops, they had returned to bomb Cassino town (see below). Events in Italy indicated that when confronted with stubborn and formidable German defences Allied soldiers would request heavy bomber support in order to overcome them. This is what occurred in North-West Europe, where such support was not provided without bitter recriminations being made by senior airmen against the Army and its willingness to fight and, particularly in Normandy, against Montgomery's competence. This theme underlies the following analysis of how effective heavy bombing was in close support of troops.

I. BOMBING.

Bombing Tactics.

The principal tactical advantage derived from employing heavy bombers against targets within the range of friendly artillery, or beyond it, was the tremendous weight of high explosive they could deliver in a comparatively short period of time. The Avro Lancaster, by 1944 the principal RAF four engined

heavy bomber, and its US counterpart the B-17 Flying Fortress, had normal individual bomb loads of 14,000-lb and 6,000-lb respectively.9 According to a British Army ORS study in 1945, a heavy bomber formation had an immediate barrage capacity

> *..out of all comparison with that attainable by any artillery concentration that can at present be contemplated.*10

Twin-engined medium bombers provided a similar advantage, but lacked the capacity of the heavy bombers. The B-26 Marauder and B-25 Mitchell, two medium types extensively used by both the USAAF and RAF, both had individual bomb loads of 4,000-lb.11 Unlike heavy bombing, medium bombing was a form of air support used from early in the war and large numbers of mediums were included in the Allied tactical air forces. Their principal role was to bring under attack targets beyond fighter-bomber range, such as headquarters and supply and ammunition dumps, and targets in the battle area which required pattern bombing, such as gun areas and troop concentrations.12

Mediums bombed in small formations, usually of six aircraft, releasing their bombs simultaneously with the formation leader. They flew tighter formations than heavy bombers and usually bombed from a lower altitude, though in the presence of flak this was rarely lower than 10,000 feet. Heavy bombers usually bombed in greater numbers and in looser formation,

creating larger bomb patterns. They often flew at an altitude of 20-25,000 feet but for some close support missions bombed from 12,000 feet or lower. On such missions RAF 'heavies' carried 500-lb and 1,000-lb bombs. Each bomber had a carrying capacity of 5½ tons and had 14 bomb hooks, a typical load being ten 1,000-lb and four 500-lb bombs. Each of the USAAF heavy bombers had a bomb load of some 2 tons but they had 40 bomb hooks, and in addition to 500-lb and 1,000-lb bombs could carry 250-lb, 260-lb, and 100-lb bombs as well as 90-lb or clusters of 20-lb fragmentation bombs. A B-17 could thus deliver over two hundred 20-lb fragmentation bombs as an alternative load.[3]

For close support both heavy and medium bombers were employed tactically either to bomb German 'Fortress' positions with the aim of destroying fixed defences and gun batteries in preparation for Allied assaults, or to support breakthrough operations in the field. The latter took the form of saturation or 'carpet' bombing on the frontage of Allied attacks with the aim of destroying or paralysing the German forward defences to a depth of some 2,000 yards, or of bombing specific areas behind the forward German line in order to neutralise gun areas, sever communications, and isolate the forward German troops from their headquarters and rear echelons. German defence localities on the flanks of a proposed Allied advance

were also bombed with the aim of isolating the German troops on the attack frontage and preventing their reinforcement and supply.14

Bombing Accuracy.

There was a significant difference between Allied heavy bombing techniques. The RAF bombed in succession with each bomber aiming individually, usually at a Target Indicator previously laid by a specialist 'Pathfinder' aircraft, and with an airborne 'Master Bomber' directing the crews by radio-telephone. The USAAF bombed in fixed formations, or boxes, of varying size, with only the formation leader aiming his bombs while the rest of the box released at the same time as the leader. The RAF method was slightly more accurate. Operational research proved that an RAF attack resulted in a pattern of bomb strikes much more dense at the centre of an objective than at the periphery, while a single US bomber box achieved a fairly even density of strikes - to achieve the cumulative ground pattern of an RAF attack several boxes of US bombers had to have the same aiming point.15

Against pinpoint military targets, such as gun positions, heavy bombing proved too inaccurate to be relied upon to achieve destruction. Assessments of bombing accuracy against such targets were made by

estimating the displacement in yards of the mean point of impact of the bombs from the aiming point, and the radial standard deviation - a measure of the scatter of bombs within a bomb pattern. The smaller the radial standard deviation, the more concentrated were the bombs around the mean point of impact. Table I shows the accuracy achieved by RAF heavy bombers on ten targets in three close support operations in Normandy. For these attacks the average radial standard deviation of the bomb pattern was 620 yards, and was found to be of a similar order for USAAF attacks. With this order of accuracy, bomb density at the assigned aiming point and over the whole bomb pattern simply depended upon the number and calibre of the bombs employed.16

TABLE I. BOMBING ACCURACY IN NORMANDY.

TARGET AREA & CODE		DISPLACEMENT OF MEAN POINT OF IMPACT IN YARDS	RADIAL STANDARD DEVIATION OF BOMB PATTERN IN YARDS
CAUMONT	B	730	750
	E	340	550
	F	360	450
CAEN AREA	1	290	370
	2	390	590
OP. 'GOODWOOD'	A1	100	810
	A2	200	910
	H1	670	560
	H2	610	560
	M	390	680

Operational research found that 100 RAF heavy bombers achieved a density of some 10 bombs per acre at the centre of their bomb pattern but that only 30% of the ground at the centre of the pattern was cratered. In view of the fact that the destructive effect of a high-explosive crater bomb extended little beyond the crater this seems unimpressive. Despite their greater number of bombs US bombers achieved even less.17

The accuracy of medium bombing depended upon the aim of the formation leader and the tightness of the formation's bomb pattern. This varied considerably. Between June and August 1943 mediums of RAF Desert Air Force were bombing point targets with an overall probable radial error of 330 yards, whereas in June 1944 the mediums of the Mediterranean Allied Tactical Air Force (MATAF) were found to be bombing point targets with an overall probable radial error of 170 yards.18 In fact the radial error of medium bombing was roughly two-thirds that of heavy bombers and, for a given number of bombs, the bomb density on point targets achieved by mediums was generally 2½ times greater than that of heavy bombers. But bomb density in the target area did not necessarily mean the target was likely to be hit. From operational data compiled in the Mediterranean theatre it was calculated that to ensure a 95% chance of a hit on a bridge target

occupying 6,000 square feet the mediums of MATAF needed to drop 600 bombs; those of the RAF Desert Air Force were required to drop 2,400 bombs.19

It was evidently difficult for mediums to hit such targets as small gun positions, occupying an area of little over 1,000 square feet, and attempts to bomb such targets were wasteful. In North-West Europe the US 9th Bombardment Division reported that medium bombardment was inappropriate for small targets because,

> *..to guarantee a reasonable probability of destruction, eighteen aircraft will normally have to be assigned, resulting at best in wasting the major part of the bomb load.* 20

That mediums were considered 2½ times more effective than heavy bombers against such targets indicates that neither form of bombing could have been relied upon to destroy them.

II. BOMBERS AS SIEGE ARTILLERY.

Defended Urban Areas.

The Cassino bombings, particularly that of the town, offered valuable lessons for those contemplating further such employment of heavy bombers. Between 8.30 am and noon on March 15th 1944 278 heavies and 177

mediums of the Allied Mediterranean strategic and tactical air forces delivered 992 tons of high explosive bombs on the town, where the Allied advance was being held by stubborn German resistance. This was followed by an 8-hour artillery programme for which 890 guns of all calibres fired 195,969 rounds at preselected targets.21 The heaviest concentration of air power and artillery yet seen in Italy, it was in close support of General Freyberg's New Zealand Corps, who were to attack the town immediately after the bombing. A subsequent bomb plot found that 47% of the bombs fell within a mile of the town centre and 53% in the general town area, but despite the weight of air and artillery firepower the attack failed, for two reasons.

The first was the resilience of the German garrison. Some 950 paratroops of First Parachute Division held Cassino on March 15th, supported by a battery of 5 assault guns. The 2nd Battalion, in the Northern part of the town, caught the full weight of the unexpected bombing, and of some 300 men, at least 160 were killed and 4 assault guns buried under rubble. Some companies were reduced to only a few men and many small parties of troops were isolated by debris. Signal communications were cut.22 Yet, as a result of sheltering in a large cave during a pause between bomber waves, most of the reserve company survived,

while others took shelter in deep cellars and the bell-shaped pillboxes that had been sunk at various points in the town. These were of steel, several inches thick, and were intended to accomodate two men - as many as six crowded into them during the bombing and they seem to have offered adequate protection. A subsequent Allied Air Force appreciation noted that

> *Bombs falling three to four yards from a pill-box lifted it out of its position without seriously harming the men inside.*23

Those German troops that survived the bombing were undoubtedly shaken, but such was the quality of the paratroops that they soon recovered and emerged from cover to engage the New Zealanders. More importantly, many of them had ample time to recover - and to dig themselves out from under the debris thrown down upon their shelters - before they were threatened by the New Zealanders' approach.

This leads to the second, and most important, reason for the failure of the attack - that the Army had insisted upon an urban area being bombed. General Ira C. Eaker, Commander of the Allied air forces in the Mediterranean, had sanctioned the bombing reluctantly and doubted its usefulness in such terrain. He warned Freyberg that the resulting debris would obstruct his tanks but was assured that this was acceptable as German armour would also be obstructed and that bulldozers would be used to clear routes,24 an

indication that the soldiers had little conception of the scale of obstruction such bombing would cause.

Instead of the planned advance rate of 100 yards in 10 minutes, the attack of the 25th New Zealand Battalion barely managed 100 yards in an hour as the assault troops tried to advance over or around bomb craters and masses of debris. Their supporting tanks of 19th Armoured Regiment fared even worse. As Eaker predicted, they could not negotiate the huge piles of rubble, and attempts by their crews to use pick and shovel or to use tanks to ram the obstacles availed little. By evening the attack was far behind schedule. The infantry had broken into the town but, while two troops of tanks were caught up amid the ruins, the rest of the armour was jammed along the only two roads leading into the town from the North. This congestion prevented engineers getting forward to clear rubble, and the single company that did reach the town could not use their unarmoured bulldozers because of close range German fire. The extent of the rubble was such that one Brigadier subsequently estimated that even without German resistance it would have taken 48 hours for bulldozers to clear a single route through the town.25 Attempts by two further infantry battalions to overcome German resistance failed. 26

Bombing Cassino had been counter-productive. The assault troops were impeded, their supporting armour

prevented from deploying, and the surviving German troops provided with a series of new, well-concealed and difficult to locate positions. The bombing may have enabled the New Zealanders to break into Cassino with fewer casualties than otherwise - the 41 sustained by the 25th Battalion were not excessive for such an attack - but the obstruction it had caused prevented them from exploiting the single most important advantage that bombing could bring to the attack - the initial disruption of the German defence. Eaker's doubts had been vindicated, and he afterwards asserted that heavy bombers should,

..never be employed in close support..when there is an adequate tactical air force present for the task..27

Cassino proved that bombing was effective in causing obstruction and, as Table II shows, the scale necessary to achieve a complete blockage of a 100-yard circle in various terrain, particularly in built-up areas, was not prohibitive. But obstruction threatened to be more disadvantageous to an attacker needing to make rapid progress than to the defender. Cassino inevitably became the byword of those senior airmen opposed to meeting Army demands for heavy bomber support,28 but it is remarkable that after Cassino the soldiers still requested heavy bombing of urban areas in the path of their attacks. When such bombing was carried out it proved of little advantage.

TABLE II (29)

NUMBER OF AIRCRAFT AND BOMBS NEEDED TO CAUSE OBSTRUCTION OF A 100-YARD CIRCLE.

	BOMBS PER ACRE	No. OF HEAVY BOMBERS (BRITISH)
HEAVILY BUILT-UP AREAS	5	50
LIGHTLY BUILT-UP AREAS (i.e. VILLAGES)	10	100
OPEN SUBURBAN & LEVEL OPEN COUNTRY AREAS	40	400
CLOSE COUNTRY AREAS (WOODS, HEDGEROWS etc.)	10-15	100-150

Operation CHARNWOOD, an attack by the British 3rd, 59th, and Canadian 3rd Divisions supported by two armoured brigades, was intended to clear the city of Caen as far as the West bank of the river Orne and to seize the crossings. The first use of heavy bombers to support an offensive in Normandy, it exceeded the errors of Cassino. First, how the operation came to be mounted must be outlined.

By mid-June 1944 there was much air force criticism of Mongomery and his failure to secure Caen and the Caen-Falaise airfield sites which the airmen had considered vital. Concern was voiced by both Coningham and Tedder at the Allied Air Commanders' Conference at Stanmore during June 14th-16th, and the former demanded that the Army press on with more urgency.30 Leigh-Mallory had already rejected Montgomery's proposal to drop the 1st Airborne Division near Caen to loosen German resistance but, anxious to assist the

Army, he flew to Montgomery's headquarters on June 14th and suggested instead a bombardment of the German positions by heavy and medium bombers on a front of 5,000 yards behind which the Army could advance. This proposal was accepted with enthusiasm, but a conference at General Dempsey's Second Army Headquarters at Bayeux to discuss the plan on the following day was broken up by the arrival of Tedder and Coningham, the latter furious that he had not been consulted. Moreover, neither strategic air force, whose representatives were present, favoured the operation.31 The task was considered the responsibility of the tactical air forces, and Leigh-Mallory was only just dissuaded by his staff from resigning immediately in protest. While acknowledging that the Army had not prepared its case well, De Guingand later admitted his disappointment,

'.for we were most anxious to try out the machinery.'32

Three weeks later, with Second Army still held before Caen, Montgomery requested heavy bombing of the city's Northern approaches and its suburbs in support of CHARNWOOD. Eisenhower was present at the Air Commanders' Conference on July 7th which agreed to the bombers being employed that evening. Tedder had not objected, though the AEAF historical record noted his disapproval:

ACM Tedder believed that the heavy bombers should not be used in the battle except in exceptional circumstances to prevent a crisis..not to prepare for an attack by our own troops.

Tedder's fear was that agreeing to the Army's request

..would encourage the Army to ask on every occasion for heavy bomber support, and that the strategic bombers would thus be unduly diverted from their proper tasks.[33]

It has been suggested that the decision to employ the bombers was as much political as military, born of the need finally to secure Caen.[34] Substance is given to this view by the fact that the bombing targets were the same as those proposed earlier but rejected by Coningham and Tedder not only on principle but because it was felt that there was little in the proposed bombing zone for them to hit.[35]

The German defence was centred on a belt of mutually supporting positions in several villages in an arc 3 miles North and North West of Caen, held mostly by the extremely tough 12th SS Panzer Division. But when, on the evening of July 7th, 467 aircraft of Bomber Command delivered 2,276 tons of bombs these strongpoints were not targeted. Instead a rectangular bombing zone 4,000 yards wide and 1,500 yards deep, including the Northern part of the city and an open area to the North West, was hit. This was to minimise the risk of bombs falling on friendly troops, as none were to fall within 6,000 yards of the forward British positions, but meant that those strongpoints

immediately in the path of the attack were not touched and had to be neutralised by artillery. Moreover, a forecast of adverse weather at the time of the attack, 4.20 am on July 8th, meant that the bombing occurred between 9.50 and 10.30 pm on the previous evening thus giving the German troops six hours in which to recover from the worst effects of demoralisation and disruption.36

Poor targeting and timing ensured that the bombing did little to assist the pace of the attack or reduce casualties, some British battalions losing 25% of their strength in the two days of fighting needed to break through the defended villages to the outskirts of Caen. On July 9th troops of 3rd British and 3rd Canadian Divisions met in the city, but armoured units attempting to rush the bridges were impeded by the huge masses of masonry thrown down by the bombs and against which even bulldozing proved ineffective. During a subsequent investigation, conducted by Professor Zuckerman and Air Commodore Kingston-McCloughry, the staff of 3rd British Division stressed that bomb craters and rubble had blocked the direct route into Caen and had impeded their advance. They questioned the decision to bomb the city and did not believe that the bombing had destroyed any German positions, as their troops had found no German dead or destroyed equipment.37 Canadian and British infantry

officers told No.2 ORS that the bombing had made Caen harder to take by denying access to armour while giving cover for German snipers and restricting the number of entrances that the Germans had to defend.38

It is not clear how many German troops in the city were killed by bombing. One prisoner stated that a headquarters had been destroyed, and others were found still stunned by vibratory shock two days later. But the ORS investigation suggested that German casualties had been relatively light. The urban area, occupied by the 31st Luftwaffe Field Regiment, had been struck by some 300 aircraft whose bombs fell to a density of 10-15 per acre in the suburbs and 5 per acre in the town. Here the ORS found the bodies of only three German troops, although more were thought to be buried under rubble, but no destroyed vehicles or equipment. The open area, struck by about 160 aircraft whose bombs fell to a density of 10 per acre, had been held by part of the 26th SS Panzer Grenadier Regiment supported by 15 assault guns of 21st Panzer with about 40 vehicles and some flak guns. Here were found the bodies of two German troops, one wrecked 88mm gun, and ten destroyed or damaged vehicles.39

The bombing certainly prevented those German troops in the urban area being supplied and reinforced, yet they resisted for longer than those units holding the approaches to Caen, mainly because the resulting

obstruction denied them a route of withdrawal - here too the bombing may have been counterproductive. This obstruction also prevented a rapid seizure of the Orne bridges (all of which were found to have been blown) and further advance into the city's Eastern suburbs.

Uncoordinated with the ground assault, the CHARNWOOD bombing was futile and, as many French civilians were killed, tragic. It is best summed up by the Zuckerman-McCloughry report which warned that it was,

> *..idle to expect the best the air can provide by calling in heavy bombers as a frill to a ground plan already made.*40

Closer air-ground coordination was seen when Bomber Command made its last raid of the war in close support of British troops. As in CHARNWOOD, the target was urban and obstruction caused similar problems for the assault troops. The bombing in support of Operation WIDGEON, the assault on the town of Wesel by First Commando Brigade during the crossing of the Rhine on March 24th 1945, saw perhaps the finest precision bombing carried out in close support by Bomber Command. Two raids were made on Wesel on March 23rd. In the first, between 5.31 and 5.41 pm, 77 Lancasters dropped 435.5 tons of bombs. In the second, closely coordinated with the Commando assault, 184 bombers dropped nearly 1,000 tons between 10.35 and 10.43 pm. This latter raid was intended to blast a way into the Northern part of the town for the Commandos, who were

waiting only 2,000 yards from the bombers' aiming point.41

Due to the proximity of the Commandos, meticulous precautions were applied by the bombers. No bombs were to fall after 10.45 pm and the Master Bomber was to permit bombing by reference to the marker previously laid by Pathfinders only when completely satisfied. No crews were to bomb unless they had positively identified the Target Indicators. Consequently the raid was very accurate, with no instance of short bombing. Soon afterwards the Commandos attacked. By 3 am on March 24th they had penetrated into the town and by daylight the entire Brigade was established in Wesel. There was only one instance of determined resistance, when the German garrison commander and his staff, who had sheltered in cellars during the bombing, defended their headquarters. In this action the German commander was killed. In all, 330 German troops surrendered in Wesel, which was secured with only 44 Commando casualties.42

Yet it was not the bombing that had prevented a costly urban battle. Of the 3,000 German troops defending the Wesel area only 350 were in the town itself, mostly low-grade Volksturm of poor morale, and the number of prisoners suggests that few had been killed by the bombing. Few showed signs of bomb-shock, such as inability to co-ordinate limbs or uncontrolled

shaking, and many had sheltered in cellars. Most German troops in the area, for the most part better quality, were deployed outside the town, untouched by the bombing. Consequently, a British Army study later admitted that bombing *'..was not essential to the success of the operation.'*43 Moreover, the obstruction made movement for the Commandos difficult and very slow, particularly at night. Officers reported that they lost their bearings as landmarks that they had been trained to recognise on maps and models no longer existed, and movement within the town had to be by compass.44 It was the poor quality of the garrison that enabled the town to be taken quickly. Against determined troops bombing Wesel could have produced another Cassino.

Fixed Defences & 'Fortress' Positions.

Despite their limited effectiveness against pinpoint targets, heavy and medium bombers were consistently directed against them when employed against German defence systems or 'Fortress' positions, such as the Channel ports. Targets were mostly gun or battery positions, but success was negligible.

On the Mediterranean island of Pantelleria in June 1943 6,400 tons of bombs were dropped upon a target area occupying only 8 square miles in 5,218 heavy,

medium and fighter-bomber sorties, but of some 130 guns in the defences only 16 were subsequently found to have been destroyed or damaged. The German coastal batteries in the British assault area in Normandy were each targeted by 100 heavy bombers and at least 5,000 tons of bombs were dropped on June 5th-6th 1944, but of 116 guns on seven beach sectors only 3 were later found to have been destroyed or damaged by bombs. At Le Havre much of the 9,631 tons dropped by Bomber Command in 1,846 sorties during September 1944 was directed at reported German battery positions, but subsequent investigation showed that of 76 German guns bombs had accounted for only eight. In the same month at Boulogne 710 tons were aimed at batteries, but bombs destroyed or damaged only 6 guns out of a total of 110. At Walcheren the German gun positions in the area assaulted by British Commandos were the target of some 5,500 bombs during October 1944, but of the 26 guns only 2 were hit.45

To bomb such targets with any hope of achieving destruction was prohibitively expensive in terms of sorties and bomb tonnage. Pantelleria proved that attacks equivalent to 70-100 heavy bombers per battery could achieve a maximum reduction in firepower of only 10-15% of guns in concrete casemates. Against guns in the open, the same scale of attack could only render 25% of the guns out of action, some permanently and

some for periods of up to 6 hours.46 At Boulogne, for 840 bombs dropped by mediums, only 1 gun had been destroyed and two slightly damaged - yet No.2 ORS subsequently admitted that the RAF had bombed,

> *..as accurately and effectively as they could be expected to and..produced as much material damage as might be expected.*

No battery had been put out of action at Boulogne by bombing, and it was calculated that to put half the guns in an open battery, regardless of size, out of action, 180 heavy bombers or, since they were more accurate, 150 mediums were needed. But to ensure destruction of all the guns, three or four times these numbers of aircraft would be required.47 After the assault on Walcheren, it was calculated that 720 heavy bombers delivering some 9,360 bombs would have been required to secure a 50% chance of destroying a casemated battery of 6 guns.48

This was due not only to inaccuracy, but also to the invulnerability of gun positions protected by concrete and steel to the bombs available in 1943-45. At Le Havre the weight of air attack had been equivalent to 20-40 heavy bombers unloading 100-200 tons on each of 12 batteries. But even direct hits had only slightly damaged the protection, up to 3 feet of reinforced concrete, of covered gun positions and a British Bombing Analysis Unit later reported that nowhere had bombing hindered the normal working of the fortress.49

On August 25th 1944 Bomber Command sent 316 aircraft to bomb 8 German coastal batteries in support of the US VIII Corps assault on the defended port of Brest, but it was later found that damage had been slight, with even the heaviest calibre bombs having little effect. The US Official History states of the Brest defences that,

> *...they were not targets that could be demolished by air attacks - no case was later found of a concrete emplacement so destroyed..*

and describes how a 12,000-lb RAF 'Tallboy' bomb had made a huge crater 200 yards from a German gun emplacement yet had failed to damage it.50

A British Army ORS study of close support bombing noted in 1945 of the Walcheren operation that the bombing of the German batteries was expected to destroy many of the guns, and somewhat bitterly pointed out that,

> *..the lessons of all the earlier operations ..had not been learnt, in spite of the fact that the results of previous experience were available to those responsible for planning the operation.*51

The limitations of bombing when directed against widely spaced or well protected military targets was apparently never appreciated by the planners of such operations. By the time of Walcheren control of the strategic air forces had reverted to the Allied Chiefs of Staff, allowing the airmen to reassert their strategic targeting priorities, and there has been

much Army bitterness that consequently the Walcheren batteries did not receive a sufficient weight of bombs. Major-General Essame observes that in October 1944 Bomber Command directed 21,930 sorties and some 56,612 tons of bombs against strategic targets, whereas only 1,616 sorties and 9,728 tons were provided in Army support. Citing the effectiveness of the Bomber Command attacks on the Normandy defences on D-Day, he writes that,

> *The air bombardment of Germany, on which the Chiefs of Bomber Command had set their hearts, could have been suspended for a few days to enable the Walcheren forts to be adequately dealt with without any appreciable lengthening of the war.*52

Yet the bombing of the Normandy defences had been effective not because of the damage inflicted or the number of guns destroyed, but because the bombing had occurred shortly before the Allied assault. The German batteries had not been destroyed, but they had been prevented from firing at their full effectiveness; if bombs did not destroy guns they at least kept the German gunners in their shelters, severed communications, and disrupted fire control apparatus at this crucial time. In 1945 the British Joint Technical Warfare Committee reported of the fire support for the Normandy landings that,

> *..bombing reduced the potential rate of fire of the coastal batteries..while naval gunfire was the only means available for producing a further appreciable but temporary reduction in enemy fire.*53

But this was quite pointless unless immediately exploited by Allied ground action. In their investigation of the air support at Boulogne No.2 ORS concluded that the only worthwhile object of bombing in periods before an assault was launched was the attempted destruction of German guns, as any damage to fortifications could be repaired before the assault while any short-lived morale effect upon the German garrison could not be exploited.54 Given the inability of the air forces to destroy guns, well known to the ORS, this amounted to saying that bombing was only cost-effective when closely followed by ground action, and that bombs dropped in raids uncoordinated with such action were wasted.

The operational evidence regarding destruction does indeed suggest that the only advantage bombing could have brought in support of operations against fixed defences was that of causing temporary disruption by drenching the target with bombs. The tragedy of Walcheren was not that the RAF failed to bomb the batteries sufficiently in the days before the assault, but that the one crucial raid, when they were to be bombed shortly before the British Commando assault on November 1st 1944, was prevented by adverse weather. In the event the German batteries, with communications damaged in earlier raids repaired, came into action

and sank or badly damaged 19 of the 27 naval craft supporting the landing and inflicted 458 casualties.[55]

In contrast, Operation WELLHIT, the assault on Boulogne by 3rd Canadian Infantry Division between September 17th-22nd 1944, indicated that heavy bombing could be effective against German defence works when closely coordinated with a ground assault. The bombing was an integral part of the assault plan which intended to exploit fully its morale and disruptive effect. Brigadier Rockingham, commanding 9th Canadian Infantry Brigade and tasked with the capture of the heavily defended Mont Lambert feature, was initially reluctant to have heavy bomber support. Concerned with the risk of 'short bombing', and that the Germans would have time to recover and man their weapons before his men had reached the objective, he suggested to General Simonds, commanding Canadian II Corps, that the approach could be made closer with just artillery support. Simonds responded by assigning to 9th Brigade an RAF Group Captain, who would be in contact with the bombers during the attack. It was also arranged for the bombers, having dropped their loads, to fly over the German positions once again with their bomb doors open to ensure that the German troops remained in cover. Rockingham later recalled of the attack by 692 heavy bombers which preceded the assault by his battalions that,

..the system..certainly worked, as did the trick of the dummy run. The Krauts stayed under cover..we had very few casualties until our troops de-bussed.[56]

The time taken by the Canadian battalions to clear their objectives depended upon such factors as defence strength and the extent of minefields and other obstacles, while some of the casualties sustained by the attackers were caused by fire from areas adjacent to the objective. Nevertheless a quantitative indication of how the bombing contributed to the success of the assault is given by the experience of the attacking battalions. The St. Martin area was bombed and the Stormont, Dundas and Glengarry Highlanders secured its Southern part in less than half a day with about 4 casualties, while the Queen's Own Rifles secured the Northern part in a day without sustaining any. In contrast, the Régiment de la Chaudière took 5 days and 58 casualties to secure Bon Secours and the North Shore Regiment 3 days and 54 casualties to secure La Tresorerie; neither target had been bombed.[57]

The effectiveness of the air support at Boulogne was investigated by No.2 ORS shortly after the assault. Those battalions that had received heavy bomber support were enthusiastic, particularly the Stormont, Dundas, and Glengarry Highlanders who had been able to take their first objectives within an hour of the bombing. The bombing had caused few German casualties,

but it had kept the defenders in their shelters at the critical time. Some 9,500 German troops surrendered, and all those subsequently questioned by the ORS stated that they had sheltered from the bombs and had made no attempt to man their weapons until the aircraft had departed. Officer prisoners described how bombing had made control and cohesion very difficult, with telephone lines cut and communication dependent upon wireless, and others told how bomb craters had enabled the Canadian troops to approach their positions unseen. While some prisoners stated that the Canadian artillery had prevented them from recovering from the effects of the bombing, the ORS emphasised that the disruptive and morale effect of bombing was only temporary, and had to be followed-up rapidly by the assault troops. They confirmed of the defenders that,

> *Everybody in the bombed areas was severely shaken and those of poor morale became worse*

but also warned that,

> *Those of better morale all said that the effect was only temporary and that they regained heart.*[58]

III. BOMBING IN SUPPORT OF BREAKTHROUGH OPERATIONS.

One limiting factor to the effectiveness of heavy and medium bombing of German defence localities in close support of attacks in open terrain was the paucity of targets offered by troops usually well dispersed. This meant that the number of German casualties and amount of equipment destroyed or damaged was unlikely to be decisive, and that sufficient troops and equipment were likely to survive to offer effective resistance.

Heavy and medium bombers were first employed against such field positions in Italy in a defensive rather than offensive context. In February 1944 heavy, medium and fighter-bombers were committed to support Allied troops defending the Anzio beachhead against determined German counterattacks. On the 17th they flew 724 daylight sorties, delivering 833 tons of bombs upon German positions and troop concentrations in the Anzio - Nettuno battle area.59 This effort, supplementing artillery and naval gunfire, was considered by the Allies to have been very effective, and the US Fifth Army later reported that the bombing,

> *..contributed greatly in keeping enemy attacking troops pinned to the ground, retarding movement, preventing full power of attack from being felt by front-line units and interfered with battle-field supply. During air attacks, enemy artillery did not*

*change positions and gun crews went into and stayed in dugouts.*60

The bombing obviously had an impressive morale effect but, in fighting a defensive battle, Allied troops had little opportunity to learn to what extent bombing had inflicted casualties and damage. In fact neither had been as great as observers believed. General Erich Ritter von Pohl, commanding all German anti-aircraft artillery in Southern Italy, witnessed the bombing of the German positions around Nettuno and later recalled that,

*The density of the hail of bombs on these positions, which..in our opinion were most vulnerable, led us to expect the complete annihilation of the unit under attack. However, on entering such a position immediately after the bombardment, one would find that aside from a few exceptions, the guns, the machine guns and the observation instruments were intact and that even the effect on the men's morale wore off after the initial experience.*61

By August 1944 the Allies had sufficient experience to be aware of this phenomenon. This is shown in an assessment by No.2 ORS of one of the Normandy operations - TOTALISE. Launched on the night of 7th/8th August 1944, TOTALISE was an attempt by II Canadian Corps to reach Falaise and was supported by 642 RAF heavy bombers dropping 3,460 tons of bombs onto 5 German defence localities flanking the attack. Afterwards, using as examples the known German defence strength in two villages in the battle, No.2 ORS outlined the level of casualties and destruction

likely to be caused by bombing. La Hogue was held by 250 troops supported by 7 guns deployed at a density of some 125 troops and 3 guns per 1,000 yards square. The ORS calculated that, targeted in two raids each of 100 heavy bombers, bombing would have caused about 30 German casualties and destroyed one gun. Roquancourt was defended by some 700 troops supported by 26 guns deployed at a density of 175 troops and 7 guns per 1,000 yards square. If targeted in four raids each by 50 heavy bombers, the ORS reckoned on the bombs causing 45 casualties and destroying at most two guns.62

Another limiting factor was that bombing could only assist the initial break-in phase of an attack. German troops beyond the bombing zone remained unaffected and success depended upon how rapidly resistance in the bomb zone could be overcome before the arrival of German reserves to seal the break-in. Much depended upon maintaining the attack momentum, but experience proved that this could be eroded by relatively few troops, guns and tanks surviving in the bombed area to offer resistance. Appropriate bomb types were another problem; crater bombing could impede German movement but also jeopardise the advance of Allied troops, while fragmentation bombing risked the German reserves being insufficiently obstructed.

That heavy bombing could be negated by defence in depth was seen in Operation GOODWOOD, an attempted breakout from the Orne bridgehead in Normandy by three British armoured divisions along a 'tank run' blasted through German defences by saturation bombing. GOODWOOD was supported by the heaviest air stike yet provided in close support; 1,512 heavy bombers and 343 mediums,[63] delivering a total of 6,000 one-thousand pound and 9,600 five-hundred pound bombs.[64] Montgomery's request for maximum air support was supported by Eisenhower, and granted by the senior airmen, including Tedder and Coningham, on the assumption that this was to be the breakout from Normandy. That this did not occur caused much recrimination against Montgomery, and left not only the senior airmen but also Eisenhower feeling that they had been duped.[65]

Bomber Command had 942 aircraft deliver 5,000 tons of crater bombs on villages flanking the tank run, which were cleared by infantry, while 650 tons of instantaneous fused bombs, to avoid cratering, were released on Cagny, the most strongly held village in the tank run. The latter, some 1,500 yards wide and stretching for 4 miles South of the bridgehead beyond the Caen-Vimont railway to the Bourgèbus ridge, was the target of fragmentation bombing by mediums of the US 9th Bomber Command. These were to neutralise the

German anti-tank guns, as the British tanks were not supported by infantry and, towards the end of its length, the tank run lacked suitable terrain for fire-and-movement tactics. By this method advancing tanks were covered by others, usually hull-down behind a crest, providing fire support, but the last 4,000 yards of the tank run lacked crest cover. South of the tank run 570 B-24s of the Eighth Air Force targeted the main German gun area with 1,429 tons of fragmentation bombs, while beyond the heavy and medium bombing zones RAF fighter-bombers attacked German reserves and artillery.66

The bombing occurred in three waves between 5.30 and 8.30 am on July 18th 1944. Unexpected by the Germans, it inflicted considerable destruction. In the Colombelles suburb of Caen, flanking the tank-run, Bomber Command's 1,000-lb bombs struck German infantry and anti-tank gun positions, and large numbers of damaged 75mm guns and German dead were later found.67 Here a regiment of the 16th Luftwaffe Division was overrun without serious resistance, with many of the prisoners taken suffering from bomb shock. When being escorted to PoW cages many had to stop and sit by the road to recover before they could walk in a straight line, and 70% of them remained stone deaf for 24 hours.68 Similarly dazed German troops were found by

the infantry clearing the villages flanking the tank run.

At Cuillerville the Mk.IV tank battalion of 21st Panzer Division and Tiger tanks of the 503rd Heavy Tank Battalion were caught undispersed by the carpet of 500-lb and 1,000-lb bombs. They were part of a battle group commanded by Colonel von Luck, who later recalled that even some of the 56-ton Tigers were overturned by blast and that craters 30 feet wide made the area impassable.69 Later examination by an RAF Bombing Analysis Unit found 15 tanks, armoured cars, and many transport vehicles in various states of destruction, some half buried in bomb craters. The 11-acre orchard had received 145 bombs, about 13 per acre, which had caused multiple ground shocks, blast waves, and the movement of debris to the order of 40,000 tons.70

British tank crews, who advanced at 7.45 am, later told No.2 ORS that the bombing in the first part of the tank run had been effective:

> *They said they were not checked by craters and were unanimous that the bombing had been of the greatest assistance in frightening and dazing the A/T* [anti-tank] *crews.*71

German gunners were found still sheltering in slit trenches and were killed by grenades, this was later confirmed by British infantry who found the bodies. This emphasis on the morale effect of the air attack

is important, as no evidence was found that German anti-tank guns had been destroyed by bombs. Only 3 guns were found in the area, and all had been destroyed by tank shells.72

Yet the German defence was not sufficiently neutralised to allow a rapid advance. In Cagny, five 88mm guns and several tanks survived to knock out 16 British tanks and a regiment had to be left to screen them; further South the British armour also came under fire from anti-tank guns positioned in the villages targeted by mediums. Only one of these had totally escaped the bombing, but in each case destruction had been partial and sufficient guns survived to hold the British armour. German fire also came from nearby woods, and it was later calculated that the bombing, concentrated upon the villages, had insufficiently covered these strongpoints.73

It was 11 am before the first 3 miles of the tank run had been cleared, and its final stretch, where most of the British tank casualties occurred, was not reached until 10 hours after the bombing. By then the British armour was being held by anti-tank guns on the Bourgèbus ridge and by German tanks that had moved up from beyond the bombing zone firing from hull-down positions on the crest and whose superior range enabled them to block every offensive move. British tank crews told the ORS that the last stretch of the

tank run should not have been bombed until they were ready to attack it, and advocated that bombing take place in a series of waves preceding an advance. In fact the tactical air forces had offered to return in the afternoon to bomb the Bourgèbus ridge, which at the extreme range of British artillery was an obvious air target, but the Staff of British Second Army refused on the grounds that by then their tanks should have reached it.74

This highlights the dilemma facing the planners of such operations. Staggered bombing may have been of more assistance to the attackers, but increased the risk of them penetrating into areas prior to a bomber strike and incurring casualties through short bombing, while to halt a successful advance in order to await a pre-arranged air strike risked the loss of valuable momentum. The solution was the provision of tactical air support by fighter-bombers able to respond immediately to requests for support as the battle progressed. In GOODWOOD the British tank crews were denied this. They could not call down the RAF's rocket-firing Typhoons which were overhead because their only contact car had been knocked out. It is a reflection on the low priority accorded to this form of immediate support, and the small extent that it was considered likely to be needed after the bombing, that only one such communications link had been provided.75

When GOODWOOD ended two days later only 7 miles had been gained, while British casualties totalled 4,011. Tank losses amounted to 493 or 36% of the total of 1,369 available.76 Harris observed that he had dropped a thousand tons of bombs to advance the Army one mile, and that at that rate it would take him 600,000 tons to get them to Berlin.77 Eisenhower was also heard to remark that the Allies could hardly expect to advance through France expending a thousand tons of bombs per mile.78 Such remarks took little account of the depth of the German defence confronting GOODWOOD. This had been seriously underestimated by the Second Army staff, who believed that the depth of the German defence extended for only 4 miles, held by the 16th Luftwaffe Division and some 1,000 troops and 50 tanks of 21st Panzer, with the depleted 12th SS Panzer as the only reserve.

Instead there were five belts of defences with a depth of 10 miles including villages strongly held by companies of infantry supported by anti-tank guns and tanks and a main gun line of 90 dual-purpose heavy anti-aircraft/anti-tank guns. Further fire support was provided by 194 field guns and 272 six-barrelled mortars, while in reserve were 45 Panther tanks of 1st SS Panzer Division and two battle groups of 12th SS Panzer Division each with 40 tanks.79 Without the bombing GOODWOOD could hardly have penetrated as far

as it did. But against a defence of such depth even the heaviest bombing could not be decisive, and GOODWOOD failed because it could be contained even after the initial break-in.

In contrast, Operation COBRA succeeded in breaking out from the Normandy beachhead because of the lack of depth of the German defences opposite US forces in the St.Lô sector. COBRA was intended to breach the German defence line 5 miles West of St.Lô in an attack by 3 infantry divisions of the US VII Corps on a front of 6,000 yards preceded by saturation bombing of an area 3,000 by 7,000 yards South of the Périers-St.Lô road. This air effort was to consist of 1,500 US heavy bombers delivering high-explosive and fragmentation bombs in three waves in three 15-minute periods, followed by a 30 minute attack by 396 mediums delivering 500-lb general purpose and 260-lb fragmentation bombs. In addition over 700 fighter-bombers in two waves, each wave attacking for about 20 minutes, were to attack with high-explosive, fragmentation, napalm, and white phosphorous bombs.80

Of the 30,000 Germans in the attack sector only 5,000 were combat troops and positioned near the front. Some 3,200 were of General Bayerlein's Panzer Lehr Division and attached parachute regiment, holding a front of about 3 miles in a series of tank/infantry/anti-tank gun strongpoints. Panzer Lehr,

depleted by previous fighting, had only some 40 combat-ready tanks, and the depth of the defence did not exceed 4 miles. The only reserve was several infantry companies and a few tanks.81

Despite poor air-ground co-ordination causing heavy casualties to US troops through short bombing, the air strike proved effective, particularly in the destruction wreaked upon German troops. This was because Panzer Lehr was caught unusually concentrated in the bombing zone. COBRA was set for 1 pm on July 24th 1944 and an unexpected postponement came too late to prevent over 300 heavy bombers and three fighter-bomber groups dropping 685 tons of bombs. Only 15% of the bombs were on target, and some fell short causing casualties to US troops, but Panzer Lehr had 350 casualties and lost 10 armoured vehicles in the bombing and subsequent fighting. Bayerlein, convinced that a major US attack had been repulsed, moved more troops and tanks into the forward area in anticipation of a renewed US offensive. Their positions almost exactly corresponded to the bombing zone when COBRA was renewed the following day.82

On July 25th 1,490 B-17s and B-24s delivered over 3,370 tons of bombs, with over 50% falling on target. 380 mediums and over 550 fighter-bombers also attacked. Some 3% of the bombs delivered by heavy bombers and some medium loads fell short, causing

disproportionately high losses among the concentrated US troops, but, according to Bayerlein, Panzer Lehr was decimated:

> *...the bomb carpets unrolled in great rectangles. My flak had hardly opened its mouth, when the batteries received direct hits which knocked out half the guns and silenced the rest. After an hour I had no communication with anybody, even by radio. By noon nothing was visible but dust and smoke. My front-lines looked like the face of the moon and at least 70 per cent of my troops were out of action - dead, wounded, crazed or numbed. All my forward tanks were knocked out, and the roads were practically impassable.*[83]

Panzer Lehr had some 1,000 casualties on July 25th, Bayerlein later asserting that 50% of them were caused by bombing and 30% by the integrated US artillery fire. He also noted the effect of the bombing on the morale of his men, saying that many survivors soon surrendered to the US troops or abandoned their positions for the rear. Command and control broke down and communications became dependent upon motorcycle messengers whose journeys were disrupted by craters and roving fighter-bombers.[84]

Craters also slowed the progress of the US troops, but so also did stubborn pockets of German resistance. Bayerlein may have exaggerated the effects of the bombing, for his account apparently does less than justice to his men. The history of the US 30th Infantry Division, one of those spearheading the VII Corps attack, is even somewhat dismissive of what the bombing had achieved:

*That portion of the bombardment that fell on the Germans shook some of them up and caused some damage. But...they had the advantage of shelters deep enough to withstand the uniformly heavy concentrations...When the assault troops approached they found the enemy doing business at the same old stand with the same old merchandise - dug-in tanks and infantry.*85

That the short bombings may have soured the appreciation of the US troops for the heavy bomber support is understandable. Moreover, many had expected the weight of air attack to eliminate all resistance, which was unrealistic.86 Nevertheless, American accounts confirm that July 25th was a day of hard fighting, by the end of which VII Corps had advanced less than 2 miles.87

Yet the back of the German defence was broken, and the limited progress of VII Corps could be exploited because beyond the Périers-St.Lô road there was no organised German defence zone, only a vacuum. With the US armour committed to the attack on July 26th, preceded by further medium bomber strikes and supported by fighter-bombers patrolling the main roads, an advance developed which within 3 days threatened to turn the left flank of the German forces in Normandy.88

Five days after COBRA Operation BLUECOAT, a thrust by British Second Army with the object of securing Vire and the 1,100-foot Mont Pincon, indicated that bombing, quickly exploited, was of tactical value in

assisting troops to secure limited objectives in open terrain. Opposing Second Army were three German infantry divisions, unsupported by tanks but well dug-in on the slopes and ridges of a terrain favouring defence. Bomber Command sent 692 aircraft to support the attack, launched on July 30th 1944, but cloud over the target permitted only 377 aircraft to bomb and only two of the six assigned target areas were covered.89 The German positions facing the 43rd and 50th British Infantry Divisions were not bombed and neither progressed much beyond their start lines.

The 15th Infantry Division attacked at 7 am, before the bombing, when two battalions without timed artillery support but accompanied by tanks secured the first objectives of Sept Vents and Lutain Wood within 2 hours. Each battalion had about 80 casualties. The bombing occurred between 9 and 10 am and was followed by an attack on the high ground at Les Loges by 2nd Argyll & Sutherland Highlanders and tanks of 3rd Scots Guards, and on Hervieux village by 10th Highland Light Infantry and tanks of 4th Grenadier Guards. Each assault was preceded by a timed artillery programme and by midday both objectives were taken. But this time the casualties were at least 43% less. One of the objectives was not directly bombed but the casualties to the assault troops were only 35; the other

battalion whose objective had been directly bombed had only 20 casualties.90

In the afternoon the final objective, Point 309, was attacked. The inflexibility of pre-arranged bomber support caused the assault troops to wait some hours for an airstrike timed for between 4 and 5 pm. While waiting, 3rd Scots Guards lost 12 tanks to German self-propelled guns. Tank crews later interviewed by No.2 ORS were critical of this imposed delay, but the bombing appears to have brought dividends. When the tanks of the Coldstream Guards and infantry of 2nd Glasgow Highlanders attacked they made such progress that the timed artillery support was cancelled as unnecessary. By 6 pm the tanks were on the objective, followed an hour later by the infantry, who had only 35 casualties. British tank losses in support of 15th Division totalled 50, including 12 lost to mines and the 12 lost by 3rd Scots Guards while waiting for the bombers. Of the remaining 26 tank losses most were caused by German anti-tank guns firing from beyond the bombing zone for, as in GOODWOOD, tank crews found German anti-tank gunners still sheltering in their trenches after the bombing. A subsequent British Army study of the 15th Division's attack acknowledged that the casualties were low compared to similar attacks in Normandy.91

IV. SHORT BOMBINGS.

Many heavy bomber support operations were marred by aircraft inadvertently releasing bombs over friendly troops. Such short bombings invariably caused heavy casualties as, unlike their enemy, dug-in and dispersed for defence, Allied troops were concentrated and often in the open waiting to attack. Table III shows the frequency of short bombings, and the resulting casualties.

TABLE III. SHORT BOMBINGS (92)

OPERATION/DATE	AIR FORCE INVOLVED	ALLIED TROOPS		EQUIPMENT LOST		
		KILLED	WOUNDED	VEHICLES	GUNS	TANKS
Cassino 15.3.44	Mediterranean Allied Strategic Air Force (MASAF)	96	200			
COBRA 24.7.44/25.7.44	8th USAAF & US 9th Bomb Division	101	463			
TOTALISE 8.8.44 (Phase II)	8th USAAF	86	286	83	7	
TRACTABLE 14.8.44	RAF Bomber Command	112	376	265	30	2
BUCKLAND 9.4.45	15th USAAF	40	120			

Apart from killed and wounded, many troops suffered concussion and shock. During COBRA General Hobbs' US 30th Infantry Division, which suffered short bombings on both 24th and 25th July, reported 164 cases of such

'combat exhaustion.' Morale could be severely affected and confidence in the air forces eroded. When the 30th Division was held by a German strongpoint on July 25th General Collins, commanding VII Corps, suggested a further medium bomber strike. Hobbs, unwilling to risk more short bombing, refused and warned Collins, *'If we have any more of the same then our troops are finished'*.93 For the rest of the war Hobbs was opposed to his Division receiving heavy bomber support.94 During TOTALISE some Allied guns fired on the errant bombers, and troops were heard to cheer as hits were scored.95

Short bombings were the consequence of insufficient integration and coordination of air and ground planning. That there was a lack of adequate liaison, mutual understanding, or even sympathy, between air and ground staffs was seen during the planning for COBRA, when such a fundamental question as the bombers' approach to the target was subject to misunderstanding. At a conference to discuss the air support held on July 19th General Bradley, commanding US First Army, advocated a parallel approach and that his troops be withdrawn 800 yards. The airmen wanted a perpendicular approach because a lateral bomb run would lead the bombers over German flak. They also wanted the troops withdrawn 3,000 yards. Soldiers were understandably reluctant to relinquish hard-won

ground, and a compromise was reached whereby the troops would withdraw 1,200 yards while the heavy bombers and mediums were to bomb no closer to them than 1,450 yards. But no assurances were given as to the bombers' direction of approach. In fact the bombers made perpendicular approaches on both 24th and 25th July, leading Bradley to accuse the air command of a *'serious breach of good faith in planning.'*[96]

Similar lack of commonality existed between the British Army and RAF Bomber Command. Charles Carrington, the Army's Liaison Officer at Bomber Command, refers to the RAF's insistence that the Army accept cratering on some operations as *'a piece of Air Force insolence',*

> *It meant that, if the Bomber Chiefs were to be diverted from Industrial Bombing to help the Army... they need not go to the trouble of studying the problem and of reloading with an appropriate type of bomb, but would take off with their normal bombload, commonly 1000lb bombs with delayed-action fuses, designed for disrupting the foundations of solid masonry.'*[97]

Poor air-ground liaison also affected such fundamentals as the provision of adequate methods of air-ground identification and communication. Those employed for COBRA were based on experience with fighter-bombers or small numbers of mediums and consisted of marking the US front line with fluorescent panels, indicating German positions by artillery firing red smoke shells, and marking US

tanks and vehicles with cerise panels and repainting their white star markings - all totally inappropriate for high altitude heavy bombers. After the first bombings on July 25th the resulting dust and smoke obscured the bomber crews' view of the battle area, even of the prominent Périers-St.Lô road, while a 5-knot wind misplaced the red smoke rising from the targets. The most serious omission was that the US troops had no means of contacting the heavy bombers. Some tanks and vehicles had radios for contacting fighter-bombers, but no such VHF link with the heavy bombers was provided.98 Unlike with artillery, the US troops had no means of correcting aim and when the leaders of three bomber formations began to bomb short, inducing following aircraft to do likewise, they were helpless to avert disaster.

Canadian and Polish troops were similarly helpless when, during the second phase of TOTALISE, two formations of B-17s mistook their positions for the target and straddled them with nearly 1,000 90-lb fragmentation bombs - with devastating effect against troops caught in the open.99 The only occasion when RAF Bomber Command caused heavy casualties by short bombing occured during Operation TRACTABLE when, on August 14th 1944, 805 bombers were sent to support a further attack towards Falaise by Canadian II Corps. Pathfinders in the second wave failed to check their

timed run from the French coast accurately and mistook a wood 4 miles nearer the coast, or 1 minute's flying time, for the German strongpoint of Quesnay Wood. Some 7% of the bombs fell on Canadian and Polish troops, who also had no means of contacting the bombers. The error was compounded by an occurrence which could have been prevented by elementary staff work. In desperation the troops fired yellow smoke, the standard method of indicating their positions to friendly tactical aircraft but the bomber crews, not of the tactical air forces, assumed the smoke to be the yellow Target Indicators generally employed by Bomber Command.100 After TRACTABLE no special technique for close support bombing was developed by Bomber Command, but the provision of an air-to-ground communications link during WELLHIT and the standard of bombing during WIDGEON showed that the lesson had been learned.

After COBRA, the Eighth Air Force developed an elaborate ground-to-air marker and communications system enabling heavy bombers to identify aiming points and the location of friendly troops with minimal risk of short bombing. This was successfully employed during Operation QUEEN, an offensive by the US First and Ninth Armies towards the Roer river on November 16th 1944. For QUEEN 1,204 heavy bombers dropped 4,120 tons of fragmentation bombs on the

fortified towns of Eschweiler and Langerwehe in the path of the US troops. Most of the bombers were equipped to receive signals from a vertical SCS-51 localizer transmitter beacon placed a short distance behind the US front line, and from two marker beacons. The SCS-51 indicated to the bomber crews their exact position in relation to the front line and the bomb release point, while the marker beacons kept the bombers on course. A ground control station was set up in radio contact with the bomber stream, and the aircrews had been given detailed briefings.

Extensive measures on the ground included a series of large panel markers indicating the approach to the front line and a line of low altitude captive balloons, flown at 2,000 feet at 300 yard intervals, placed 4,000 yards behind the front line perpendicular to the bombers' approach. Four batteries of 90mm anti-aircraft guns placed 8,000 yards behind the front line fired a line of red smoke shells on the same line as and above the balloons, These were timed to give 8 simultaneous bursts every 15 seconds at a height 2,000 feet below the altitude of the bombers, the timings coordinated by direct telephone and radio link between an air controller and the batteries.[10]

Consequently no bombs fell on US troops during the approach to the target, and although the bombing was from 18,600-24,000 feet due to cloud over the target

and flak, all targets received a high proportion of hits. The unexpected bombing caused heavy casualties among some German units caught in the open as they were being relieved (the 1st Company of the 981st Infantry Regiment had 30% losses) and the US troops initially encountered only weak resistance. But by late afternoon the Germans had begun to recover and resistance stiffened. QUEEN failed to become a breakthrough, for three reasons.

First was the depth of the German defence system; it took 3 days for the US troops to break through the outer defences and by then the effect of the initial air bombardment had been lost. Second, November gave limited hours of daylight for fighter-bombers to prolong the effect of air attack. Whereas COBRA on July 25th had 16¼ hours of daylight, QUEEN had only 7¾ hours, and much of this was disrupted by poor weather with the result that only 349 sorties were flown. But the third and most important reason was that, although the Americans had done much to solve the problem of short bombing, the memory of COBRA prevented complete confidence among the air and ground staffs in deciding how far the heavy bomber targets should be from the US troops. Their caution ensured that the US troops were unable to exploit fully the most important effect of the bombing. As a subsequent US study of QUEEN acknowledged,

> *..with the satisfactory safety and accuracy aids devised, the heavy bombing effort could have been placed much closer to the front line, thus permitting the infantry to press home the advantage of the shock effect..*102

However, that the most elaborate precautions could minimise, but not eliminate, the risk of short bombing was shown during the opening phase of Operation BUCKLAND, the attack across the River Senio by the V British and II Polish Corps in April 1945 - the Eighth Army's role in the final Allied ground offensive in Italy. Heavy bomber support was provided by the Fifteenth Air Force, whose aircraft were also to support US troops as part of a general air operation code-named WOWSER.

The safety precautions for WOWSER/BUCKLAND surpassed those for QUEEN. In addition to a series of large white ground markers placed along the bombers' route to the target area and indication lines of anti-aircraft shell bursts at pre-arranged heights, arrangements were made for a 'last-minute' cancellation of the bombing. In the American sector this took the form of a VHF forward radio control established at the headquarters of the Army's supporting Tactical Air Force (22nd TAC), while in the British sector a series of flak bursts forming the letter 'X' was to indicate that the heavy bombing had been cancelled. Moreover, a familiarisation programme was conducted in the days before the offensive whereby

the lead bombardiers and navigators of the heavy bomber groups were flown over the Allied troop positions and the route to the target area in reconnaissance aircraft, the experienced pilots of which pointed out the front line and target markers. Some 175 such flights, each of over one hour's duration, were flown.103

BUCKLAND commenced on the afternoon of April 9th, some 825 B-17's and B-24's carpeting German positions along the Senio with 1,692 tons of (mostly) fragmentation bombs. This was followed by fighter-bomber attacks on specific gun positions and command posts. The bombing was well concentrated and was, for the most part, followed up quickly on the ground, a subsequent report stating that,

> *In many instances troops in the attack zones were so confused and demoralized by the attacks that they offered no resistance to advancing Allied forces and surrendered without a struggle.*104

However, not all the bombs landed among German positions. Through aircrew error one formation of 18 heavy bombers unloaded over the concentration area of a Polish battalion, causing heavy casualties. Eighth Army later admitted that,

> *..if more attention had been paid to ensuring that troops took cover during the heavy bomber attacks casualties would not have been so heavy*

but rightly added that this,

*'..in no way excuses the complete error in bombing which was made by the aircraft concerned.'*105

V. OPPORTUNITY COSTS.

Close air support accounted for only a small fraction of the Allied heavy bomber effort. From D-Day to the end of the war in Europe RAF Bomber Command flew 182,549 operational sorties, of which less than 10,000 sorties were provided in close support. Even if the total of sorties directed against targets other than in close support but which were related to the ground battle, such as attacks on communications, is included the total is still less than 24,000 sorties.106 During the same period the Eighth Air Force flew over 227,000 operational sorties of which less than 10,000 were in close support.107

Moreover, heavy bomber losses in close support operations were far from prohibitive. They encountered little or no air opposition, while the flak encountered was either effectively smothered by the bomb carpet or silenced by friendly artillery. Table IV outlines the number of Allied heavy bombers lost during the principal close support missions in North West Europe, and shows that for a total of some 14,826 sorties losses amounted to only 53 aircraft, or 0.35%.108

TABLE IV. HEAVY BOMBER LOSSES DURING CLOSE AIR SUPPORT OPERATIONS IN NORTH WEST EUROPE

OPERATION/DATE		No. OF BOMBERS DESPATCHED		NUMBER LOST	PERCENTAGE
Invasion Support	5/6.6.44	RAF:	1,012	3	0,2%
		8th USAAF:	2,587	4	0,15%
CHARNWOOD	7.7.44	RAF:	467	4	0,85%
GOODWOOD	18.7.44	RAF:	942	6	0,63%
		8th USAAF:	644	1	0,15%
COBRA	24.7.44	8th USAAF:	909	1	0,11%
	25.7.44	8th USAAF:	1,581	5	0,31%
BLUECOAT	30.7.44	RAF:	692	4	0,57%
TOTALISE	7/8.8.44	RAF:	1,019	10	0,98%
	8.8.44	8th USAAF:	681	7	1,02%
TRACTABLE	14.8.44	RAF:	805	2	0,24%
WELLHIT	17.9.44	RAF:	762	2	0,26%
QUEEN	16.11.44	RAF:	1,188	4	0,33%
		8th USAAF:	1,239	none	
WIDGEON	23/24.3.45	RAF:	298	none	

This can be contrasted with the losses sustained on other mission types. Table V shows Bomber Command losses in raids upon communications (mostly railway) targets in France and synthetic oil plants in Germany during June 1944 alone, losses amounting to 210 aircraft in 3,840 sorties, or 5.4%. Table VI shows Eighth Air Force losses in raids against strategic targets in Germany during June-July 1944. In addition to aircraft missing in action these include returned aircraft written-off through damage, losses being 276 aircraft in 12,664 sorties, or 2.1%.109

TABLE V. BOMBER COMMAND LOSSES AGAINST COMMUNICATIONS AND OIL TARGETS JUNE 1944.

MISSION/DATE		No. OF BOMBERS DESPATCHED	NUMBER LOST.	PERCENTAGE
Communications	6-7/6/44	1,065	11	1.0
"	7-8/6/44	337	28	8.3
"	10-11/6/44	432	18	4.1
"	12-13/6/44	671	23	3.4
Oil	12-13/6/44	303	17	5.6
Communications	15-16/6/44	224	11	4.9
Oil	16-17/6/44	321	31	9.6
Oil	21-22/6/44	139	37	26.6
Communications	28-29/6/44	230	20	8.6
"	30/6/44	118	14	11.8

TABLE VI. EIGHTH AIR FORCE LOSSES AGAINST STRATEGIC TARGETS IN GERMANY, JUNE-JULY 1944.

MISSION/DATE		No. OF BOMBERS DESPATCHED	NUMBER LOST.	PERCENTAGE
Germany	21/6/44	1,234	47	3.8
"	29/6/44	1,150	19	1.6
"	7/7/44	1,129	40	3.5
"	11/7/44	1,176	25	2.1
"	13/7/44	1,043	20	1.9
"	16/7/44	1,087	16	1.4
"	19/7/44	1,242	21	1.6
"	20/7/44	1,172	20	1.7
"	21/7/44	1,110	34	3.0
"	29/7/44	1,130	18	1.5
"	31/7/44	1,191	16	1.3

Yet the important questions are to what extent the diversion of effort to close support hindered persistence with the strategic campaign, and whether this could be justified.

Unlike, for example, the bombing of communications targets in France during the spring of 1944 as a prelude to OVERLORD, the relatively small heavy bomber effort accorded to close support in 1944-45 did not result in a significant reduction in the level of

attack upon strategic targets. Nevertheless, further escalation of close support missions, the trend of which was seen in Normandy before the breakout, posed a potentially serious threat to the effectiveness of the strategic offensive. This would have been hard to justify because, although hampered by disputes over targeting priorities, the bomber offensive ultimately proved to have decisive results.

One result was that the bombing of oil targets, with particular emphasis upon those plants producing aviation fuel, brought the Luftwaffe to the point of collapse. In April 1944 German production of aviation fuel stood at 175,000 tons, by June it was reduced to 55,000 tons, in July it was 35,000 tons, falling to 16,000 tons in August and only 7,000 tons in September. The resulting fuel famine compelled the Luftwaffe to cease initial flying training, nearly all medium and heavy bomber units were disbanded, while aerial reconnaissance and army support were severely curtailed. This, along with the need to concentrate air resources to defend the Reich, meant that the Luftwaffe virtually disappeared from the battlefronts.[10] The strategic offensive was thus a major contributary factor to the air superiority enjoyed by the Allied tactical air forces.

Moreover, the Luftwaffe's fighter force, almost totally committed to defence against the daylight

bombing of Germany, was relentlessly destroyed through air combat attrition. A post-war RAF analysis of fighter losses in defensive operations examined the Luftwaffe's battle against the USAAF daylight offensive over Germany between November 1943, when long-range US fighters began to accompany the bombers deep into Germany, and August 1944. It observed that,

> *The G.A.F.* [German Air Force], *at the beginning of the period, was numerically inferior to the attack and this inferiority increased steadily throughout the period. The average exchange rate between defence and attack was about ten German fighters to eight U.S.A.F. aircraft, and this in the circumstances, worked very much to the detriment of the defence. The G.A.F. attempted to respond to the increased frequency of attack but only by decreasing the average size of the fighter force deployed for any given raid. In other words the defence was wasting away, and was probably a beaten force even before petrol shortage became an important factor.*[111]

Over a thousand German fighter pilots were lost between January and April 1944 alone, among them many irreplaceable experienced operational commanders.[112] Such losses inevitably brought a decline in quality and fighting efficiency as inadequately trained pilots were committed to battle, which in turn invited heavy casualties.[113]

The effect of bombing upon the German economy and capacity to wage war was difficult for Allied strategists to determine accurately at the time, but subsequent research has confirmed that it was great. With regard to industrial output Richard Overy has pointed out that,

*Bombing placed a ceiling on German war production which was well below what Germany, with skilful and more urgent management of its resources, was capable of producing after 1943.*114

In late 1944 there began an increased emphasis upon the bombing of transportation targets within Germany. In October Tedder had argued that the primary Allied air objective should be German communications, this being,

> *The one common factor in the whole German war effort, from the politcal control down to the supply of troops in the front line..*115

Tedder's plan was adopted by SHAEF and ratified by the Combined Chiefs of Staff on November 1st, the result being that communications targets were accorded second priority after oil. The effectiveness of the subsequent offensive upon German communications, particularly the German railway system, has been analysed by Alfred C. Mierzejewski, who states that,

> *..the repeated bombing of marshalling yards, canals, and viaducts denied real resources to German industry and to the Wehrmacht. It prevented the distribution of coal, fatally disorganized the exchange of components, and compelled German industry to consume its reserves of both.*116

The attrition of the Luftwaffe, the destruction of German oil producing capacity, and the disruption of German industry and communications could only be achieved and maintained by a continuous bombing offensive. It was not enough to bomb such targets as factories, oil refineries and marshalling yards once; if they were to remain inoperative repeat attacks were

necessary at intervals when the weather allowed. Thus the strategic air forces might be faced with the choice of assisting the armies or putting an oil refinery out of action for several weeks. In view of this, Army demands for heavy bomber support, and the level of such support that was provided, appears far more consequential than the number of sorties might suggest. While there was scope for a limited diversion of heavy bomber effort to assist the armies without seriously compromising the bomber offensive, escalation could only have been at the expense of achieving strategic goals.

Hence the bitter recriminations of the airmen when, in their opinion, the Army wasted or misused bomber support, and their concern at increasing Army demands for such support. In October 1944 the British Chief of the Air Staff, Air Chief Marshal Portal, wrote to Tedder that,

..the constant application of heavy bomber power to the land battle, when it is not essential and when its only purpose is to save casualties, must eventually lead to the demoralisation of the Army..

Tedder agreed, and observed that the Army had indeed been *'drugged with bombs'*[117]

The airmen were acutely aware of the need to maintain the pressure upon Germany, but the soldiers were primarily concerned with their need to overcome German defences at less cost, for which they were

willing to risk the drawbacks of employing the heavy bombers - even short bombing. The result was a bitter divergence of views, exacerbated by unfortunate timing. In 1944-45 Army demands for bomber support occured at the time when the strategic air offensive was at last starting to show positive results. Yet the soldiers were aware that, in both Italy and North-West Europe, but particularly the latter, infantry casualties were proving far heavier than had been anticipated, and for the British and Canadians reached crisis proportions due to the lack of replacements. [18]

CONCLUSION

The operational results of employing the strategic air weapon in a tactical role were mixed. No close support operation by heavy bombers was ever completely successful, being marred either by short bombing, insufficient casualties and damage being inflicted upon the Germans to be decisive, or by the consequent obstruction hindering the Allied troops. The reason was that, as the senior airmen knew, heavy bombers were poor battlefield attack aircraft. They lacked flexibility to respond to the changing patterns of the land battle. Unlike the tactical air forces, trained

to work in close liaison with ground forces, heavy bombers could not be called up at short notice by the forward troops to assist the progressive stages of an advance; Lancasters and B-17s could not fly cab-rank.

Heavy bomber strikes from bases distant from the battlefront required detailed planning and staff work, crew briefing and aircraft preparation. Their intervention brought a rigidity to the battle area, with troops having to relinquish often hard-fought ground in order to observe bomblines much more extensive than those imposed by tactical aircraft. Consequently the heavy bomber contribution to offensive operations could only be made in the initial stage of a set-piece attack.

The object of bombing was then to render German forces vulnerable to attack and incapable of resisting effectively by causing the maximum possible destruction, obstruction, and demoralisation. Bombing had the potential to inflict heavy casualties upon German troops and to destroy much of their equipment, but only when they were concentrated in the bombing zone. Such occurrences were rare. In open areas German forces were too well dispersed to offer profitable targets. The bomb pattern achieved in an attack by RAF heavy bombers on any one target, regardless of the weight of attack, remained fairly constant, with nine-tenths or more of the bombs falling within a 1,000

yard radius. Against widely dispersed targets this was uneconomic. Some positions were overhit with others remaining untouched, while many bombs fell where there were no German positions at all.119

For the same reason pinpoint targets were very difficult to destroy by bombing and required a prohibitively high investment of sorties and bomb tonnage to offer a reasonable chance of destruction. This explains the small amount of equipment found destroyed and the relatively few German dead subsequently found by ORS investigations, though with regard to the latter there is reason to believe that the Germans removed their dead before the arrival of Allied troops when opportunity allowed.

With the possible exception of Panzer Lehr during COBRA, the level of casualties and destruction caused by bombing was never enough to be in itself decisive - but with regard to COBRA the critical factor in the success of the operation was the lack of depth of the German defence. Bombing was more successful in causing obstruction. On June 30th 1944 266 aircraft of Bomber Command delivered 1,100 tons of bombs on a road junction at Villers-Bocage in Normandy through which tanks of the German 2nd and 9th Panzer Divisions would have to pass in order to counter-attack the Allied beachhead - the resulting obstruction ensured that no such attack took place.120 This was an example of what

only heavy bombing could achieve, but in close support the causing of such obstruction also hindered the progress of Allied troops. Yet when, as in the GOODWOOD tank run, fragmentation bombs were employed in order to avoid this the amount of destruction inflicted upon the well dug-in German troops was less than could have been achieved with high-explosive crater bombs. This dilemma could never be satisfactorily solved, and the only workable method evolved was to use fragmentation bombs in the path of an attack while crater bombing was employed on German rear areas and on the flanks to obstruct German counter-attacks.

The principal advantage of heavy and medium bombing in close support was that of rendering German troops and equipment temporarily incapable of functioning as a result of vibratory shock and also, temporarily, reducing the morale and will to fight of troops subjected to intense and prolonged bombardment. As Charles Carrington observed, *'The enemy were dazed and deafened rather than killed.'*[2] Bombing came with little warning, and to the effect of surprise was added the shock caused by the tremendous concentration of firepower that the bombers could deliver in a short time. Even if few troops were killed or wounded, many were left reeling from the effects of such bombardment, communications with headquarters were

often cut and, though few guns and tanks were actually destroyed, many were unmanned and buried under debris. In the period immediately after sustained heavy bombing the whole machinery of defence was disrupted and left vulnerable to attack.

One example of the weight of high explosive that the bombers could deliver is seen by comparing the bomb tonnage and weight of artillery employed at the start of WELLHIT. In an initial fireplan lasting 85 minutes 328 guns fired 19,324 shells, or 524 tons, whereas 690 heavy bombers dropped 3,356 tons - the weight of artillery being less than 20% of the high explosive delivered by the bombers.122 This was vital to the success of the operation, as the supporting artillery was insufficient to silence the German batteries which caused most of the 634 casualties sustained by 3rd Canadian Division during the assault.123 Without the bombing the Canadian artillery would have been overcommitted, unable to both neutralise the German defences at the outset of the attack and engage in counter-battery fire, with Canadian casualties consequently heavier or the operation postponed.

When its disruptive and morale effects could be rapidly exploited by the assault troops, as at Boulogne and during BLUECOAT, heavy bombing could save both time and casualties. The available artillery alone could not have smothered the German forward

defences to the extent necessary for operations on the scale of GOODWOOD or COBRA to be mounted, and tactical aircraft, while more appropriate than heavy bombers for rapid-response and progressive close air support, lacked sufficient bomb carrying and delivery capability. The value of fighter-bombers, and even mediums, lay in extending and prolonging the effects of bombardment initiated by the heavy bomber strike. Both GOODWOOD and QUEEN would have progressed further had tactical aircraft been able to intervene more effectively, while during COBRA the provision of continuous fighter-bomber cover for the US armour was a decisive factor in the subsequent success of the breakout.

Yet a further commitment to close air support by the heavy bombers, beyond supporting the armies at the outset of a limited number of major operations, could not have been justified. It would have meant a reduction in the strategic offensive for which they had been developed and trained, and the wasting of a major asset, in that a strategic weapon would have been, as the airmen feared, frittered away in a tactical role when there already existed large tactical air forces. Results on the battlefield would not have justified such a step, while to abate the strategic offensive would have almost certainly permitted Germany to continue the war beyond May 1945.

A greater commitment to close support would have been equally inappropriate for medium bombers, for they enabled the tactical air forces to strike at targets beyond fighter-bomber range, and at battle area targets requiring a greater weight of attack.

Yet, on occasion, heavy and medium bombers could provide an important increment to the firepower available to Allied troops. The problem in 1944-45 was that on such occasions their value was compromised by poor air-ground liaison. The drawbacks with such support were not inevitable. Operations BLUECOAT, WELLHIT, COBRA, and even GOODWOOD though it ultimately failed, proved that German defence effectiveness could be significantly, if temporarily, reduced while both WELLHIT and QUEEN proved that the risk of short bombing could be minimised. While it would have been unsound to devote valuable time and effort to train the heavy bomber forces for close support, a greater degree of liaison during the planning and execution of operations would have ensured both that the bombing was better exploited and that fewer Allied troops were killed by Allied bombs. That this did not occur until a late stage was the responsibility of both the senior airmen and soldiers - the former because the bomber support was only grudgingly provided, and the latter because they failed to comprehend and adjust to its inherent characteristics.

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CHAPTER VII.

FIGHTER-BOMBERS AND ARTILLERY: A COMPARISON OF EFFECTIVENESS.

Introduction.

The campaigns in Italy and North-West Europe in 1943-45 saw developments in air/ground communications and control resulting in an improved level of responsiveness and air/ground integration between the Allied armies and their supporting tactical air forces. Both campaigns also saw the results of similar, and parallel, improvements in communication and responsiveness within the ground forces' intrinsic close support arm - the artillery. The object of this chapter is to determine the relative merits of artillery and tactical aircraft in the close support role, and to address the question of why, when both the British and US artilleries had become proficient at rapidly concentrating firepower in the immediate support of infantry and armour, close air support was considered necessary.

I CHARACTERISTICS.

The most important advantage of artillery was that it could provide fire support in all weathers, day or night. In contrast, the fighter-bombers of 1944/45 were unable to operate effectively at night, while their employment in daylight could be prevented or considerably reduced by adverse weather, even in summer. Normandy in June and July 1944 saw more cloud, wind and rain than at any time recorded since 1900 and on many days air missions could not be flown. For example, between June 26th and July 24th the US IX TAC was able to fly only 900 sorties in support of US First Army, it being calculated later that the weather had cancelled as much as 50% of the potential air support.

In winter, with fewer daylight hours and the increased likelihood of poor flying weather, a reduction in available air support was inevitable. The experience of RAF Desert Air Force in Italy may be taken as typical. In November 1944 there were nine days during which the weather permitted only 180 sorties to be flown; in December there were at least 10 days when operations were completely suspended or confined to weather reconnaissance sorties and a further eleven days when operations were restricted.

In January 1945 there were seven days when flying was impossible and a further three days confined to weather reconnaissance sorties.2

Artillery, moreover, could command a considerable area - including the zone within 7,000/8,000 yards of the line of contact where close air support was likely to be required. Shelford Bidwell has observed that the 25-pounder gun/howitzer, the principal British and Commonwealth field gun of World War II with a fighting range of 11,000 yards and an arc of 90°, when positioned 3,000 yards behind the front line, could dominate 30 square miles of enemy territory.3 The principal British and US artillery equipments of 1943-45 are shown in Table I.4

TABLE I. PRINCIPAL BRITISH AND U.S. ARTILLERY EQUIPMENTS.

	TYPE	RANGE IN YARDS / MILES.	RATE OF FIRE
British	25-pounder gun/howitzer	13,500 (7,6 miles)	4 rounds per minute
	5,5-inch gun/howitzer	16,200 (9,2 miles)	1 round per minute
	7,2-inch howitzer	16,900 (9,6 miles)	1 round per minute
U.S.	155-mm gun	25,715 (14,6 miles)	1 round per minute
	155-mm howitzer	16,000 (9 miles)	2 rounds per minute
	105-mm howitzer	12,500 (7,1 miles)	4 rounds per minute

The ranges of these guns show to what extent artillery could dominate the battle area, and in the early stages of both campaigns it was an avowed principle of the Allied Tactical Air Forces not to engage targets

within artillery range. In 1944 the RAF Desert Air Force in Italy reported that

> *When it is possible to put smoke onto a target by shell fire, it will usually be found that (the) request for air support against that particular target will be refused, the reason being that it will be considered to be an artillery target.*5

This was also the view of the USAAF. A former US fighter-bomber pilot recalls of a spell of duty as a forward air controller in Italy that,

> *One ground rule was that air strikes were not to replace artillery. Attempts had to have been made to take out targets by artillery, or reasons given why they couldn't, before we accepted and sent air strikes on them.*6

Yet, for the air forces to refuse all targets within artillery range would have ruled out close support. That this did not happen was initially the result of necessity. A post-war US study of air support admitted that,

> *..the previous air force conception that fighter bomber aircraft should not be used on targets within the range of ground artillery should not be an inflexible rule. Early in ..NORMANDY it became apparent to staff officers in the combined air-ground operations centers that various factors affected this preconceived tenet, and that each request should be considered from all angles..*7

One of these factors was whether enough guns were available to engage a target successfully. In 1944 RAF Desert Air Force acknowledged that, even if a target could be indicated by artillery, it would be attacked by fighter-bombers if insufficient guns could be brought to bear.8 Linked to this was the question of

whether the terrain in the battle area allowed for suitable artillery deployment, an acute problem in the mountainous areas of Italy.

There were occasions when it was imperative for fighter-bombers to act as a substitute for artillery. One such occurred in late June 1944, after storms swept the OMAHA and UTAH landing beaches in Normandy and disrupted the scheduled arrival of artillery units and ammunition. Fighter-bombers of the US 9th Air Force had to be employed in close support against what normally would have been regarded as artillery targets. This proved successful, and a subsequent US study acknowledged that,

> *...a refusal of requests from corps and divisions for close air support against targets that were within artillery range could have had a serious effect on our efforts to consolidate the beachhead and capture the Port of CHERBOURG.*9

Another reason why close support from fighter-bombers was sometimes essential was shortage of artillery ammunition. For example, the participation of the Desert Air Force fighter-bombers in Operation CYGNET in Italy in January 1945 (see above, Chapter IV) had been requested primarily because of the severe shortage of artillery ammunition in Eighth Army at that time which saw the 25-pounders restricted to only 10 rounds per gun per day.10

Responsiveness.

Close support, either by fighter-bombers or artillery, consisted of either pre-arranged airstrikes or artillery bombardments laid on as preparation for a planned attack, or of impromptu support provided in response to developments at the battlefront. The latter, to be of use to those requesting it, had to be provided quickly. Fighter-bombers, flying from landing grounds often considerable distances from the target area, could not normally provide such support as rapidly as artillery positioned at or near the battlefront. Such support was the primary task of artillery, and both British and US divisions possessed considerable organic artillery firepower.

Each US infantry division had three battalions of field artillery, each with twelve 105mm howitzers, and one battalion of twelve 155mm medium howitzers. Its British counterpart had three regiments of field artillery, each of twenty-four 25-pounders subdivided into three batteries of eight guns which in turn were subdivided into troops of four guns. British and US armoured divisions were also equipped with self-propelled artillery (see Chapter IV above).||

By 1944 Allied gunners were able to concentrate the fire of these guns in response to support requests with remarkable speed. In the British and Commonwealth

forces this was due to the adoption of a fire control system which enabled support requests to be rapidly answered by the fire of massed guns, the principal factor being an efficient network of radio communication. Each troop and battery commander of a British artillery regiment was equipped to form an obervation post (OP) and, while remaining independent, batteries became affiliated to support particular battalions. This inculcated the battery commander and his OP officers with a strong committment to support 'their' battalion, and they usually became regarded as as much a part of the battalion as its company commanders. 12

By radio the Forward Observation Officers (FOO's) attached to the forward troops, those with armoured regiments riding in their own tanks, could call direct for fire support from, if required, every gun within range. Troops, batteries and regiments all operated on the same radio network, or 'net', and were controlled by a master OP working on a headquarters frequency able to 'step in' and directly order regiments to engage targets - functioning in much the same way as the RAF's Forward Control Post in the broadly similar Air Support Signals Unit system.

This method was pioneered by Major-General H.J. Parham when serving as Commander Royal Artillery (CRA) of the 38th Division in England in 1941. By dispensing

with the hitherto 'hierarchical' chain of command in dealing with support requests (i.e. from troop to battery to regiment to headquarters for approval and back) much time was saved. Moreover, Parham dispensed with the lengthy pursuit of extreme accuracy in artillery fire when dealing with such requests, realising that speed was of more importance. In a conventional fire control system the fire of a battery could be corrected quite rapidly by adjusting to left or right or longer or shorter by the battery's own sights, but in other batteries engaging the same target compensating corrections had to be calculated. In Parham's system this was obviated, a new type of fire order being introduced using compass points. Shelford Bidwell describes how guns could be ordered to shift their fire, say, to a point 400 yards North-East of where it was falling, abbreviated to *'Go N.E. 400'* - an order applicable to every battery without correction regardless of the position of the OP. The resulting spread of shot when engaging a target simultaneously with three or four regiments compensated for initial inaccuracy in spotting the target. 13

The system became known by the letters of the phonetic alphabet employed; 'UNCLE' for 'U' which was a call for support from the entire divisional artillery, and 'MIKE' for 'M' calling for the fire of

a regiment. It was not intended to replace more traditional methods, such as accurate survey which was vital in the preparation of fireplans for predicted fire, but it did provide a means of handling massed artillery as a single fire unit, able to switch fire rapidly from point to point by radio control in response to any emergency. Its simplicity enabled infantry and tank officers to understand and use it if their accompanying FOO became a casualty, and it could be extended to call on the guns not just of one division but also of other divisions, and of the separate groupings of field, medium, and heavy artillery of the Army Groups Royal Artillery (AGRA's) that were usually attached to Corps. And it was fast; divisional concentrations could usually be put down within 5 minutes of the radio alert of an 'Uncle Target'.14 Even when further extended the system remained swift. The attack on the HITLER LINE in Italy by First Canadian Corps on May 23rd 1944 saw the first employment of the WILLIAM TARGET, calling on the guns of an entire army corps, and on one occasion a call for support was answered by 19 field, 9 medium, and 2 heavy regiments engaging the target simultaneously with 668 guns - 3,506 rounds, or 92 tons of high explosive, being delivered within 33 minutes of the original request.15

The system employed by the US artillery differed in that forward observation officers were precisely that; they observed, reported, but could not order fire. Decisions as to whether a target were engaged, the number of guns and scale of fire employed were taken by more senior officers at a fire direction centre behind the battlefront. This meant that decisions were based on much wider intelligence than provided by a single FOO in the front line caught up in his own particular battle, but the response time could be slower than in the British system.16 However, against targets that had been previously registered the US artillery could respond very quickly, concentrating fire in a few minutes upon the receipt of the appropriate code word.17

By 1943-45 the effectiveness of both the British and US artilleries had been further increased by the provision of specially trained observers flying over the battlefront in light observation aircraft and in direct communication with the guns. Targets that would not have been observed from the ground could be rapidly engaged once spotted from the air. This is seen in an example from the fighting for the Anzio beachhead in Italy in February 1944. During a German counterattack on February 18th Captain William H. McKay, a US artillery observer flying over the battle area in an L-4 Cub observation aircraft, spotted over

2,000 German troops supported by tanks moving to exploit a breach made in the Allied line. He radioed this information to the artillery of the US 45th Division, and within 12 minutes the VI Corps Fire Control Centre had concentrated the fire of over 200 guns - including some British - on the target, which shattered the German force; within the next 50 minutes McKay caused four further German attempts to be similarly broken up.18 Such was the success of air observed fire that by this time many missions were directed in this way, for example the US First Armored Division's Air OPs were firing more than fifty per cent of all observed missions.19

In general, fighter-bombers having to fly to the battle area could not equal artillery response times, though it is true that the distance from fighter-bomber airfields to the battlefront varied considerably as the campaigns progressed. In the early stages of the Normandy campaign, due to the shallowness of the beachead, Allied fighter-bombers occupied hastily constructed airfields very close to the front line; Desmond Scott recalls that when his Typhoon wing (No.123) moved to Normandy in mid June 1944 their airfield, near Caen, was only four miles from German positions and often under shellfire.20 In such circumstances fighter-bombers were able to take off, attack their targets, and return in a matter of

minutes, and sometimes airfield personnel were able to watch the aircraft attacking the targets that were so close.21 Frequently, however, fighter-bombers had to attack targets many miles from their airfields. In France during August-September 1944 the US Third Army was advancing Eastward from Normandy and also reducing German garrisons in Brittany. This required units of the supporting US XIX TAC to be widely deployed in order to be able to attack targets that were sometimes 500 miles apart.22

In Italy and North-West Europe in 1943-45 it was found that a request for air support from the forward troops took an average of about 75 minutes to fulfil, the time broken down as in Table II. This could be more or less, depending upon such variables as distance from the forward airfields to the battle area, and the availability of aircraft and their state of readiness.23

TABLE II. TYPICAL AVERAGE FIGHTER-BOMBER RESPONSE TIME, 1944.

Forward army unit to Army/Air joint HQ:	9 minutes
Wing Headquarters to Army unit, arranging estimated time of arrival over target:	12 minutes
Writing messages, pilot briefing, and consultations at Army/Air joint headquarters:	34 minutes
Flying time to target:	20 minutes
Total:	75 minutes

Much depended upon how quickly a fighter-bomber squadron could become airborne after having been detailed to attack a target. In 1944 RAF Desert Air Force outlined the time breakdown for a squadron at 45 minutes readiness, meaning that all aircraft could become airborne 45 minutes after receipt of the target by the Wing Operations Room, as follows:

1) Target is received at Wing Operations Room from the Air Support Control and MORU.
2) Wing Operations Room alerts the Squadron Operations Room for briefing, whilst they are en route the Wing Commander, ALO's, and Intelligence Officer gather the necessary information for the briefing.
3) Pilots are briefed, taking at least 15 minutes providing no further information is required from Air Support Control.
4) Pilots proceed to dispersal and board their aircraft, arrange maps and flying gear, start up and move up to the assembly point on the runway, all this taking at least 10 minutes.
5) The squadron takes off, forms up, and sets course for the target. As only one aircraft could usually take off at a time at least 12 minutes elapsed before course was set for the target. The squadron then had to reach the target, which could take anything up to an hour depending on the distance of the airfield to the battlefront. 24

Moreover, after returning from a sortie a considerable time elapsed before a squadron of fighter-bombers could become airborne again in response to a further request. This was due to the time needed for refuelling aircraft and rearming them with ammunition and bombs, or 'turning around' a squadron as it was called. In 1944 the Desert Air Force found that it took 1¾ hours to 'turn around' a squadron of Kittyhawk IV's, the time divided as follows:

Total time for refuelling squadron (approximately 10 minutes per aircraft) with the usual two petrol bowsers available: 1 to 1½ hours.
Total time to rearm and bomb-up aircraft (approximately 15 minutes per aircraft) with two crews available working while the aircraft were also being refuelled: 1½ hours.
Time for taxying out to the assembly point and take-off: 12 minutes. 25

The only method whereby fighter-bombers could respond to support requests in a space of time comparable to artillery was that of flying continuous patrols over the battle area on CABRANK (see Chapter IV above). Some indication of the responsivenes possible with CABRANK is shown by an incident during the Rhine crossing which occurred on March 26th 1945. The 154th Infantry Brigade of 51st (Highland) Division called up the FCP in their sector to report a German strongpoint in some houses that was delaying their advance. The Contact Car with the Brigade was authorised by the FCP to call down a section of Typhoons from CABRANK and immediately contacted and briefed the pilots. Within 3 minutes artillery had marked the target with smoke, and within 8 minutes of the original request the Typhoons had successfully attacked.26

This, however, should be regarded as exceptional. An average response time was more likely to have been similar to that recorded for an air support request made by the 9th Brigade of 3rd Canadian Infantry Division during the same operation. The Canadians called up the FCP controlling their sector giving a target of German tanks and asking for the estimated arrival of aircraft over the target. Once the RAF Squadron Leader at the FCP had checked aircraft availability and given an estimated time of arrival

the Canadians were asked when coloured smoke could be fired to indicate the target. The Brigade replied that they could *'smoke it this minute if you are ready'* whereupon the decision was made to assign the mission to aircraft on CABRANK in the battle area; briefing details and even an available air photograph of the target area were passed to the controller who then briefed the pilots. In an interesting link up between the artillery and air support communications systems, during the airstrike contact was maintained between the artillery and 9th Brigade by telephone and from 9th Brigade to the FCP by radio-telephone, so that the fall of smoke could be immediately reported to the aircraft. Results of the airstrike were then passed to 9th Brigade, the entire operation taking 18 minutes from the original request to reporting of results.27

CABRANK offered the immediate availability of fighter-bombers to engage targets, but for aircraft to achieve responsiveness on a par with artillery was hardly economic. Keeping aircraft continually over a given area of the battlefront was wasteful in both flying hours and petrol stocks, especially as fighter-bombers were frequently kept waiting in vain for targets and had to leave the CABRANK to attack an alternative target in the battle area for which the pilots had been briefed before take-off. Such alternative targets were no doubt important, but were

obviously not of the highest priority and it is questionable whether attacking them in any way compensated for the absorption of air effort involved. An artillery weapon, when not required, involved no such wastage.

Moreover, the commitment of aircraft necessary to maintain a CABRANK inevitably resulted in a diminution of air effort at other sectors of the battlefront. For example, in Italy on November 7th 1944 the Desert Air Force flew no less than 309 sorties, most of them CABRANK, in support of the attack on Forli by the British 46th and 4th Infantry Divisions alone, while No.83 Group's effort in flying 233 sorties on CABRANK in support of Guards Armoured Division during the first day of Operation MARKET GARDEN in Holland on September 17th 1944 had required the commitment of ten squadrons.28 Even in the CABRANK sector the weight of air attack against targets was often diminished, because in order to maintain continuous patrols fighter-bombers were seldom able to operate in more than sections of four aircraft.

II BATTLEFIELD EFFECTIVENESS.

Having established that, at a high cost in air resources, fighter-bombers could be as responsive as artillery to requests for support, an obvious question is whether their attacks were as effective as artillery fire. There are two criteria of effectiveness; the destructive effect, referring to the level of destruction and casualties inflicted, and the morale effect.

Destructive Effect.

Against such typical close support targets as gun positions, strongpoints, and field works, the effects of fighter-bomber attack and artillery were remarkably similar. Pinpoint targets, such as individual gun positions, were not easily destroyed. This was largely a question of accuracy, as neither artillery nor the air delivered bombs and rockets of 1944-45 were precision weapons, while such targets proved quite resilient to near misses. The following shows the limited amount of destruction achieved by Typhoons against German gun positions in North-West Europe, during operations WELLHIT, the assault on Boulogne in

September 1944, and INFATUATE, the capture of Walcheren Island in November 1944: 29

TARGET	NUMBER OF ROCKETS FIRED	NUMBER OF STRIKES ON TARGET	% OF STRIKES
4 Heavy & 6 Medium Gun Emplacements	216 (27 Typhoon loads)	2	0,9%
3 Heavy & 4 Medium Gun Emplacements	104 (13 Typhoon loads)	9	8,6%
4 Medium Gun Emplacements	62 (8 Typhoons - 1 with 6 R/Ps)	2	3,2%
4 Heavy Gun Emplacements	47 (6 Typhoon loads)	1	2,1%

Similarly, during Operation UNDERGO, the assault on Calais in September 1944, it was subsequently discovered that no damage to weapons had been achieved in twelve separate Typhoon attacks on six gun positions, involving the expenditure of 375 rockets.30 This level of destruction improved little as the capaign progressed. ORS 2nd TAF investigated a number of German gun positions attacked by Typhoons in response to requests from the forward British troops in Germany in April 1945; they found that only 3 guns had been damaged out of 64 attacked in twelve positions.31

Against similar targets artillery apparently had only slightly more destructive effect. Table IV shows the density of artillery fire and damage caused by British and Canadian medium guns when engaging a battery of German 88mm guns during operations to clear the Channel Ports in September 1944. On this occasion it was discovered that even if a medium shell landed in the gunpit, the chance of putting the gun out of action was small.32

TABLE III. EFFECTS OF COUNTER-BATTERY FIRE IN NORTH-WEST EUROPE.

TARGET	NUMBER OF GERMAN GUNS	NUMBER OF GERMAN GUNS KNOCKED OUT	NUMBER OF ROUNDS IN A CIRCLE OF DIAMETER 300 YARDS	DENSITY OF ROUNDS IN lbs PER SQUARE YARD
I	5 x 88mm	1	3,600	.051
II	6 x 88mm	2	5,700	.081

Much the same level of destruction was found in Italy when the British Army's No.1 ORS examined the effects of counter-battery fire on German field gun and 'nebelwerfer' multiple-barrel mortar positions. They found that of 44 guns and nebelwerfers in 22 positions only 8 (18%) were damaged.33

The lethality of artillery and air attack was also variable. Against fieldworks the effectiveness of rockets and bombs was questionable. In 1945, after

analysing operational data from the fighting in Germany, ORS 2nd TAF noted that,

> *..open positions consisting of trenches and fox-holes suffered little or no damage from this type of attack.*34

Bombs needed direct hits to destroy such positions, while the anti-personnel value of rockets was limited against troops in fieldworks. In 1945 the joint No.2 ORS/ORS 2nd TAF investigation of Typhoon effectiveness admitted that the 60-lb semi armour piercing (SAP) rocket, with which Typhoons were equipped, could,

> *..only be seriously lethal if it happens to catch men inside a building which it penetrates; against troops in the open it penetrates too far into the ground to be dangerous.*35

In the same report the ORS noted that they found only one instance of significant personnel casualties being inflicted by rockets. This occurred during the assault on Calais (Operation UNDERGO) where a Canadian Medical Officer reported that he had attended to 70 German casualties, 12 of whom (17%) were thought to have been rocket victims.36 In fact it was found that only strafing attacks had been successful in inflicting significant casualties upon troops in fieldworks, the higher degree of accuracy possible and the larger number of rounds fired offering an increased chance of rounds penetrating trenches and foxholes and finding a mark.37

The level of personnel casualties inflicted by artillery was also variable, but most evidence suggests that relatively few casualties would be caused by even heavy bombardment to troops occupying well protected positions. This can be seen in an example of German artillery engaging Allied troops which was considered to be of sufficient interest for the US Army to record it. On the night of 2nd October 1944 some 200 US troops occupying deep and well protected foxhole positions were subject to a bombardment by German mortars and artillery in preparation for an attack by German assault engineers and infantry. Between 2,000-3,000 high-explosive rounds were fired and covered the US positions in an area 1,500 by 1,000 yards, yet the US casualties caused by this and the subsequent fighting amounted to only 8 men, or 4%. 38

But troops less well protected or in the open could expect heavy casualties from artillery. In early 1944 No.1 ORS of the British Army reckoned that if enemy troops occupied only slit trenches, and were subject to a rate of fire of one 25-pounder shell per 42 square yards for a period of some 4 hours, then about 17% casualties would result. If the more lethal airburst shells were employed, then 30% casualties could be expected.39 An example from the Italian campaign seems to confirm this. On September 19th 1944

a regiment of British 25-pounders fired 432 rounds in an hour on each of two German hill top positions in the GOTHIC LINE near Casaglia. The fire was observed from an OP and was seen to cover an area 300 by 300 yards, later ground examination showed that one shell had burst every 6 yards. Early the following day British troops captured 6 prisoners from the position who stated that their company had sustained 23 casualties during the shelling and had afterwards withdrawn, taking their casualties with them. The German troops had occupied slit trenches only 1-2 feet deep, and some had been in the open, and many of their casualties had been from splinters caused by airbursts.40

Such artillery bombardments, of some duration, are not really comparable with fighter-bomber attack. Unlike fighter-bomber pilots, artillery gunners had the opportunity to correct aim and bring their targets under prolonged fire.41 However, if a rapid concentration had to be put down quickly in response to a request for fire, pinpoint accuracy would not be possible. Similarly, when conducting counter-battery fire against enemy gun positions with the intention of silencing them, the object was to saturate the target with fire. In this respect, the effectiveness of both artillery and fighter-bomber attack depended not so much on the target being destroyed, but neutralized -

in other words the morale effect could be more important than the destructive effect.

Morale Effect.

Early in 1944 the British Army attempted to analyse the morale effect of artillery fire. The following quotation from a report by No.1 ORS suggests that opinion varied as to whether a sudden, short, but heavy bombardment would have a more pronounced effect than one of longer duration:

> *Psychologists consider that if men are exposed to sufficient strain for a sufficient length of time they will be brought to a state of moral collapse such that for a considerable period they will be unable to fight effectively.... The essence of the kind of collapse intended is that it takes a considerable time to recover from it. Men may be petrified with fright by a short, intense bombardment and yet recover in a minute or two after the shelling ceases. But according to the psychologists...a much less frightening experience (though still above a certain minimum of strain), if continuous and prolonged, will ultimately produce a breakdown from which recovery will be a matter of hours.*42

Whether a morale effect was achieved at all depended upon a number of variables. One was the nature of the defences protecting the target troops; they had to feel vulnerable. A British Army report on artillery fire in 1944 noted that,

> *It has been established...that if men are in such strong defences that casualties can not be inflicted they are not likely to be demoralised by any bombardment, however long sustained, and such bombardments are a waste of ammunition.*43

Another variable was the quality of the troops under bombardment. Troops of poor morale, especially of low grade formations, or who were inexperienced, might be more susceptible to demoralisation. In contrast, troops of high quality often proved remarkably resilient, obvious examples being the German paratroop defenders of Cassino and the SS troops containing the British and Canadian troops around Caen - both of whom offered determined resistance to Allied attacks even after saturation bombing by heavy bombers and the heaviest artillery bombardments.

Some weapons caused a greater level of demoralisation than others. By the end of 1944 Allied gunners were employing the radar proximity fuse (originally developed for anti-aircraft use) which had a greater lethality than conventional shells. This was first employed by US forces during the fighting in the Ardennes in December 1944 and proved so deadly, especially against troops caught in the open, that General Patton was moved to write that,

> *The new shell with the funny fuze is devastating. The other night we caught a German battalion, which was trying to get across the Sauer River, with a battalion concentration and killed by actual count 702. I think that when all armies get this, we will have to devise some new method of warfare.*

By the end of 1944 ground based rocket systems for saturation fire were also being employed in North-West Europe. British 21st Army Group had submitted a

requirement for a weapon capable of delivering a very large weight of shell in a short period of time, resulting in twelve 'Rocket Projectors 3-inch Mark I', enough to equip one battery of two troops each of six projectors, being sent to First Canadian Army. Known as 'Land Mattress', they were a development of the Royal Navy's 'Sea Mattress' rocket system used to provide area concentrations in support of seaborne landings. Each wheel-mounted projector had 30 barrels arranged in 5 banks of 6. Fired electrically by remote cable control, Land Mattress could fire either single rounds or a 'ripple' and had a maximum rate of fire of 30 rounds in 7¼ seconds, the time between salvoes being some 10 minutes.

Land Mattress could quickly saturate an area with fire; it was calculated that one salvo from a regiment of 36 projectors in 7¼ seconds could neutralise an area of 350,000 square yards, whereas an equivalent salvo from medium artillery required sixty regiments of 5.5-inch guns. Moreover, the destructive effect of the rockets, each equivalent to a 100-lb shell, was great due to their large high-explosive content, while the noise of the rockets in flight and their detonation had a pronounced demoralising effect on the enemy. German prisoners stated that they considered Land Mattress far superior to their own Nebelwerfer rocket projector, and that it was greatly feared. The

rockets also had a heartening effect on friendly infantry, particularly as experience during attacks proved that they were able to advance safely within 500 yards of their impact, thereby giving the enemy little time to recover. Land Mattress had two major drawbacks, however; a slow rate of fire compared to orthodox artillery and the amount of time needed to assemble ammunition - it took a detachment of 9 men some 1½ hours to unload, unbox, assemble and replace 30 rounds carried in a 3-ton lorry and this could not be reduced by dumping as the rockets were affected by moisture. First Canadian Army remained the sole user.45

One problem regarding the morale effect of such special ground based weapons was that their particular properties could go unnoticed amidst the general unpleasantness of a bombardment when they were employed with conventional artillery, as was usually necessary. This was discovered after the heavy preliminary artillery concentrations at the outset of VERITABLE, the operation to clear between the rivers Maas and Rhine by First Canadian Army in February 1945, to which both radar proximity shells and Land Mattress had contributed. Subsequent interrogation of prisoners revealed that the Germans had been completely unaware of them - including a specialist

artillery observer who had monitored the bombardment from an OP in the Reichswald.46

In contrast, fear engendered by air-to-ground weapons tended to be more pronounced. One would expect that fear of a weapon would be linked to its lethality, and a British prisoner of war interrogation report from Normandy confirmed that German troops feared strafing above all and that the terror effect of this form of attack varied in inverse proportion to the altitude from which it was delivered, strafing from low level being particularly feared.47 The Americans similarly discovered the demoralising effect of strafing. The US XIX Corps reported an occasion when its light armoured units were trying to take a wooded hill strongly defended by anti-tank guns and machine guns; supporting fighter-bombers bombed the position but German resistance remained such that the US tanks still could not advance:

> *The squadron was asked to come down again and strafe the positions after which the position was taken. PW's said the bombing was not so bad, but when the 'Jabos' strafed them they lost all will to fight and tended to make the men scatter for protection regardless of orders. Many were found hiding below the ground and they didn't offer much resistance. Many were killed at their guns and in their foxholes by the strafing.*48

Similarly, during the fighting in the Colmar Pocket in January 1945, the advance of the US 3rd Infantry Division was held at a canal by German troops firing

across it from a wood. All available fighter-bombers of XII TAC were called up and strafed the wood for 30 minutes after which

> *..what was left of the enemy came to the bank of the canal with hands up.*[49]

American fighter-bombers were also equipped with what was probably the most terrifying air-to-ground weapon of all; napalm. Apart from the fearsome nature of the weapon, its morale effect was enhanced by the fact that it could cause considerable damage and casualties, especially when employed in conjunction with more conventional bombs or even artillery fire. Napalm was used extensively by the US Ninth Air Force in North-West Europe, and in early 1945 its ORS described how napalm considerably reduced German defence effectiveness:

> *...heavy artillery and/or GP* [general purpose] *bombing destroys or damages buildings, communication facilities, prepared defences; consequently, the enemy must utilize masses of rubble and smashed houses as.. defense positions. Napalm...upon the devastated area renders these temporary emplacements untenable, causes fires to take hold in the wreckage, and drives the enemy into the open....The enemy troops who are not evacuated have, in a majority of cases, taken refuge in cellars, and are subject to assault without being able to offer effective resistance.*[50]

When attacking German positions in woods, US commanders preferred supporting fighter-bombers to be equipped with napalm rather than with conventional fragmentation bombs. This was because on the arrival of the fighter-bombers German troops always took cover

in their slit trenches which normally afforded them good protection, whereas napalm caused casualties and generated unbearable heat which forced the Germans out of these positions.

While targets such as dense, wet woods, stone and concrete buildings, and concrete and steel pillboxes proved resistant to napalm's destructive effect, their occupants were not immune to fear of the weapon. After the assault on the SIEGFRIED LINE in October 1944 the US 117th Infantry Regiment reported that, although little damage was done to pillboxes by either general purpose or napalm bombs, the napalm,

> *..had a tremendous psychological and physical effect upon the enemy troops occupying the defenses outside the pill-boxes. These outer defenses were given up because of the napalm attack forcing the enemy troops into the pill-boxes. This..enabled our attacking troops to get to the rear of these fortificatons, utilize pole charges and seize the pill-boxes...P/W's stated that napalm did not bother them while they were in pill-boxes; however, the demoralizing effect was great and fear of further attack by "fire bombs" persuaded them to stay in their pill-boxes.*51

Yet a weapon did not need to have a high lethality in order to have a pronounced morale effect, as the German attitude to rocket fire proved. For their joint investigation of Typhoon effectiveness No.2 ORS and ORS 2nd TAF questioned about 100 German prisoners, and found that *'..all who had been attacked by rockets expressed their dread of the weapon.'* In view of the limited destructive effect of the rockets against

defence positions the ORS were somewhat at a loss as to why this should be so, and concluded that it was

> *..quite definite that it is the nature of the attack that upsets the Germans and not the physical damage which it causes. None of the prisoners had seen any damage or casualties caused by the attacks which had so scared them.*52

Three reasons were suggested to account for this fear of rockets. One was that exaggerated tales of the effects of rocket attack had spread among German troops; another was the noise generated by a diving Typhoon, and the third was the unnerving sight of the approaching rockets.53

With regard to close support of attacks by infantry and armour, it was vital to know what scale of effort was likely to be required to neutralize the target and for how long the German defenders were likely to be affected. In both North-West Europe and Italy experience showed that the morale effect of bombardment, either by air or artillery, was of short duration and that if it was to be exploited it was imperative to attack immediately or as soon as possible after the airstrike or artillery bombardment. But operational data from these campaigns also indicates that air attack was able to achieve such a morale effect quicker than artillery, and that it was likely to be of longer duration.

Much depended on the quality, motivation, and level of immunity from physical danger of the German troops

on the receiving end of any bombardment, but, as one example, an Unteroffizier (Sergeant) of the German 578th Grenadier Regiment, taken prisoner at Il Casone in Italy on September 30th 1944, told his British captors that artillery concentrations were terrifying while they lasted but had no such effect by about three minutes after they had ceased. He also stated that German troops manned their defence positions and weapons as soon as the shelling was over as they knew the British infantry would be attacking.54

This can be contrasted with what could be achieved by fighter-bombers. The American experience with napalm related above suggests a morale effect of much longer duration, while the joint RAF/British Army ORS investigation of Typhoon effectiveness calculated, on the basis of combat experience, that,

> *..if..three flights of 4* (Typhoons) *attack a position at intervals of 15 minutes, there is probably a period of 10 to 20 minutes afterwards during which enemy are in no condition to offer stiff resistance to attack by ground forces.*55

A typical example was cited which had occurred on October 13th 1944 during the heavy and prolonged fighting for Overloon in Holland. That morning a battalion of British infantry of the 3rd Division attacked a German held wood some 300 yards from their own woodland positions. This was unsuccessful and they were driven back across the open ground with some casualties. Air support was then requested and a

Typhoon strike made on the German positions at 2 pm. The battalion immediately advanced and took the position, this time without opposition, its commanding officer reporting afterwards that not only had the rockets,

> *..successfully unnerved the enemy..they had also put new vigour into his own men who were somewhat disconsolate after the casualties..of the morning.*[56]

This is but one of a number of recorded examples which indicated that, apart from having a morale effect of longer duration, air attack could also cause a sudden change in the determination of German troops to resist at all. For example, the US 90th Infantry Division recorded of its attack on Lightenborn in Germany in 1945 that

> *German troops surrendered after short skirmishes only after 2 air attacks on positions...while before they defended the objective for 24 hours with bitter resistance.*

The US 9th Infantry Division recorded simply that,

> *Every time we have an air mission the rate of surrender goes up.*'[57]

The most striking examples of this occurred when fighter-bombers precipitated the surrender of German positions without the need to attack. During the assault on the Crozon Peninsula in Brittany by the US 8th Infantry Division a German strongpoint refused to surrender, but on the approach of fighter-bombers white flags immediately went up. Similarly, later in

Germany, the US VII Corps reported how the town of Nastatten capitulated after being only 'buzzed' by fighter-bombers.58 Similar experiences were recorded by British and Canadian forces. On November 1st 1944 the 8th (Canadian) Reconnaissance Regiment demanded the surrender of a German strongpoint on the island of North Beveland, which was refused. Air support was requested from 2nd TAF's No.84 Group which, while committed at that time to the Walcheren operation, agreed to send a squadron of Typhoons over the island as a show of strength. The Commander of the 8th Recce Regiment warned the Germans that his supporting aircraft would make one pass without firing, but that afterwards they would attack. The 18 Typhoons appeared on schedule, flying low across the island, and as soon as they had passed over the first Germans came out to surrender - the 8th Recce Regiment taking 450 prisoners in all.59

Apart from the morale effect, there were also more practical reasons why Allied troops came to prefer close air support to that of artillery. One was that fighter-bombers could deliver in a shorter space of time a very heavy weight of firepower, which in itself must have been a contributory factor to the enhanced morale effect. A squadron of 15 Typhoons, each with eight 60-lb rockets, could deliver 7,200-lb - or 3.6 short tons - of high explosive on a target. This was

the equivalent of a regiment of 25-pounder guns firing at 3 rounds per gun per minute for four minutes and would have been delivered in approximately the same time. However, in a similar space of time the same number of Typhoons, each with two 1,000-lb bombs, could deliver up to 15 short tons - to achieve this a regiment of 16 British 5.5in medium guns, each firing at the rate of one 100-lb shell per minute, would have had to fire for some 20 minutes.

It is true that the fire of many artillery regiments could be concentrated on a particular target and in both campaigns TOT ('Time on Target') fire, the bringing to bear of all guns within range to fire on a single target simultaneously, became a frequent practice.60

However, this type of fire was less useful than fighter-bomber strikes because artillery bombardments did not permit the assault troops to approach as near to their objective, so as to take maximum advantage of the neutralisation or morale effect before those enemy troops not killed or wounded recovered from the shock of bombardment. A post-war US study discussed the merits of artillery and fighter-bomber attacks in close support and observed that,

> *..best results were obtained from fighter bombers in their close support role when the...attack was concentrated on key points of resistance within very close range. Range dispersion of our heavy artillery capable of firing an equivalent weight of projectile, i.e., the 240 mm howitzer or the 8" gun*

*or howitzer would not permit fire this close, even if this artillery or the ammunition therefore were always available. On the contrary, effective bombing with 500 lb.GP or 260 lb. fragmentation bombs was conducted by fighter bombers against close-in enemy positions sometimes within 300 to 500 yards of our own forward elements. Moreover, it was felt by many commanders that the terrific destructive effect on personnel, materiel, and morale of a fighter bomber attack concentrated on close-in enemy positions was worth more than any artillery preparation, if the air attack was followed immediately by a determined infantry attack.*61

To what extent infantry became accustomed to exploiting fighter-bomber support was demonstrated to the RAF by Canadian troops in Northern France in 1944. Two pilots from No.84 Group were attached to a battalion in order to see close air support from the ground. They were taken to a viewpoint 150 yards from an isolated German pillbox which an infantry company was about to assault after a planned airstrike by Typhoons. Having seen the target, they asked the company commander when they were to move back to watch the strike go in, knowing that the danger zone extended far beyond their present position. They were surprised when told that the strike was expected in 5 minutes and that there they would stay. The Typhoons arrived on schedule, their rockets hit the target area, and the infantry immediately attacked and took the position without loss. The incident did not conform to current theory either in the attack position of the infantry or the effectivess of the

rockets, but the company commander had witnessed previous airstrikes and was more confident of the result than the RAF pilots, who had failed to appreciate that experienced infantry preferred the risk of casualties from their own aircraft to the greater danger of lengthening the time and distance of the assault.62

In much the same way attacking infantry were prepared to 'lean on' an artillery barrage, a belt of fire moving across enemy positions, by following very closely upon the bursting shells in order to arrive on the objective before the Germans had time to recover. A textbook example of British artillery successfully neutralizing a German defence position occurred during Operation CLIPPER, the attack on the Geilenkirchen salient by 43rd (Wessex) Division in Germany. On November 18th 1944 the 5th Dorsets attacked the village of Bauchem, held by some 200 German troops positioned in open trenches around the village, and cleared it at the cost of only 7 casualties, while taking 180 prisoners. A subsequent ORS report on the attack observed that the Germans,

*..offered not the slightest resistance, and (were) described by the attacking troops as looking 'absolutely yellow coloured.' P.W. interrogated later were clearly very shaken physically and said they had felt quite overwhelmed with a sense of helplessness in the face of immense superiority.*63

But such effective neutralisation by artillery generally took much longer to achieve than that by fighter-bombers. The fire support for the Dorsets had consisted of 10 minutes artillery fire followed by fire from mortars, 20mm and 40mm guns, and tanks lasting for 3 hours and finally by a further bombardment of artillery lasting just over 30 minutes - or 184½ tons of high explosive delivered over 4 hours. This had not inflicted heavy casualties, German losses amounting to between 10-15%, while so closely had the Dorsets 'leaned on' the final barrage that 4 of their 7 casualties had been caused by their own artillery.65 That artillery was unlikely to achieve effective neutralization without such prolonged and heavy fire was indicated by other attacks during the same operation. The objectives of the 7th Somerset Light Infantry, 1st Worcester, and 5th Duke of Cornwall's Light Infantry were the villages of Neiderheide, Rischden, and Hochheid respectively. All three objectives were bombarded for only 20-40 minutes, and the artillery fire was not followed up quickly - the 7th Somerset Light Infantry being 30 minutes behind their concentrations. Although the objectives were taken, the difference in the level of fire support and the speed of the follow-up between these attacks and that at Bauchem is reflected in the casualties on both sides. This time German casualties

were estimated to have been only 5%, while those of the British were reported as being *'..several times greater in each battalion than at Bauchem..'*[65]

To achieve effective neutralization artillery bombardments required a lavish outlay of ammunition. As preparation for the opening of Operation VERITABLE on February 8th 1945, the area assaulted by twelve British and Canadian battalions with tank support had been bombarded by field, medium, and heavy artillery from 0500 hrs to 0920 hrs, while at the same time the German forward defences were the target of a 'Pepperpot' - harassing fire from every available tank gun, mortar, anti-tank gun, anti-aircraft gun and medium machine-gun. At 0920 hrs a barrage was started by field and medium artillery and lasted for 6 hours. In all 1,050 artillery pieces fired some 91,330 shells (1,596 tons) in the bombardment and 160,388 shells (2,793 tons) for the barrage. Yet, of the total of between 2,250 and 2,700 German troops of the 84th Infantry Division holding the front in extensive field defences, a subsequent British Army ORS investigation estimated that less than 60 had become casualties to shellfire. Even the neutralization had been patchy, the ORS adding that,

> *..when the fire support was followed up closely, the enemy surrendered at once. But the effect...was transitory. Three battalions got well behind the shelling for one reason or another and found the enemy recovering and beginning to resist.*[66]

The price of failing to exploit the temporary neutralization was high, while 1,115 Germans were taken prisoner, many of them reported as being quite shaken by the bombardment, British and Canadian casualties amounted to 349 (459 if those caused by mines are added). Similar use of artillery on a lavish scale persisted throughout the course of VERITABLE, but some felt this to be counter-productive. The commanding officer of 1st Gordon Highlanders complained on February 26th that artillery fire was excessive, causing too much mud and destruction, and that it warned the enemy of impending attack; he called for shorter fireplans with the infantry closer behind.67

This was the crux of the problem of artillery in close support. Not only were barrages expensive in ammunition, they also demanded precise timing which could often be a matter of considerable difficulty, a post war British study of wartime artillery tactics noting that experience proved that'*..the rate of advance as planned was seldom achieved in practice.*'68 Mostly the problem was that the barrage advanced too fast, leaving the infantry behind. This is what occurred on one occasion at Cassino, when a barrage advancing at 100 yards in six minutes began to leave the infantry behind from the start. Similarly, during the attack on Caumont in Normandy, British tanks had

to push on far ahead of the infantry they were supporting in order to even reach and cross the start line for the attack before the effects of the barrage had worn off. Occasionally the barrage could instead be too slow. After an attack during the fighting at Overloon in Holland British infantry complained that the barrage, fired by three divisional artilleries and moving at a rate of 100 yards in 5 minutes, had actually delayed their advance.69

Fighter-Bomber Barrage.

One solution to this problem, which proved successful in both Italy and North-West Europe, was to extend the barrage by employing waves of fighter-bombers to provide what amounted to a moving belt of fire support in the path of an attack. With artillery indicating the target area, the fighter-bombers were able to give the closest possible support to infantry and armour, while retaining sufficient elasticity, lacking in pre-timed artillery barrages, to conform with the ground situation at any time during the progress of an attack.

The first such example occurred in Tunisia in March 1943. During the battle to break through the MARETH LINE, the New Zealand Corps of British Eighth Army were confronted by a valley stretching Northwards

between two ranges of hills leading to the village of El Hamma. The Italian infantry defending this 6,000 yards bottleneck had been reinforced by the German 164th and 21st Panzer Divisions with anti-tank guns and minefields, so that a formidable obstacle blocked the route to Gabes. On learning of the problem, Air Vice-Marshal Broadhurst, then commanding Western Desert Air Force, conceived the idea of exploiting the Allied air superiority by using all available air units in a concentrated attack upon this narrow front with the object of paralysing the defences for long enough to allow the New Zealand infantry, followed by armour, to break through. Broadhurst's plan was welcomed with enthusiasm by Eighth Army, but not so by Broadhurst's immediate superior, Air Marshal Sir Arthur Coningham, commanding Allied North-West African Tactical Air Force, who had no wish to accustom soldiers to having such air resources subordinated to their operations and who was also concerned about losses likely to be incurred by aircraft attacking at the very low level suggested by Broadhurst. However, because such use of aircraft could be justified in view of the small threat by then posed by the depleted Axis air forces, the Desert Air Force plan went ahead.70

At 3.30 pm on March 26th three formations of light/medium bombers struck the Axis positions from

low level, pattern bombing with the aim of creating disorganisation and severing telephone communications. They were followed immediately by the first relay of fighter-bombers, bombing and strafing from low level, the target area indicated by artillery firing red and blue smoke while the New Zealanders burned yellow smoke to indicate their own positions. A strength of two and a half squadrons of fighter-bombers was maintained in the battle area, fresh relays arriving every 15 minutes, the pilots bombing specific targets and then strafing gun positions. For the first time they were receiving radio instructions during their attacks from an RAF officer observing the battle from an OP with the forward troops. At 4 pm the infantry attacked, under the cover of a barrage moving at the rate of 100 feet a minute and the main object of which was to define a bomb-line for the fighter-bombers which were continually bombing and strafing in front of the line of bursting shells. This 'air blitz', as it was termed, lasted for 2½ hours and a total of 412 sorties were flown for the loss of 11 aircraft. The operation was successful, the infantry and armour having broken through and advanced 6,000 yards by dusk with only light losses.71

The next occasion when Desert Air Force fighter-bombers were similarly employed occurred in Northern

Italy. By November 11th 1944 the British V Corps had cleared Forli and advanced to line of the River Montone, though further progress was held by German positions on the East bank occupied by troops of the 278th Infantry Division supported by tanks and self-propelled guns. The terrain in the area was well suited to defence, being low lying ground, too soft to allow armour to deploy off the roads, and dotted with numerous farms and houses which had been turned into strongpoints. The V Corps decided to clear these positions employing the 12th Brigade of 4th Infantry Division, but also requested close air support from Desert Air Force and, in particular, a solution to the problem of safe bombing over a fluid bombline. The RAF response was 'Timothy'.

On November 12th the 4th Brigade attacked in three phases of approximately 1,000 yards advance. First artillery laid a coloured smoke bombline as instructed by the ROVER control 300 yards ahead of the forward troops. At 7.30 am, 8.30 am, and 9.30 am fighter-bombers, in flights of 12 aircraft arriving every ten minutes, bombed and strafed everthing in sight to a depth of 1,000 yards parallel to, and 1,000 yards either side of, the brigade axis of advance. After a few minutes the intensive 'blitz' was lifted and the infantry advanced. By the end of the day the 12th Brigade had advanced over 2,000 yards and taken 106

prisoners at the cost of 13 casualties.72 On the following day, after a further six 'Timothy' attacks by 12 squadrons, including rocket firing US P-47 Thunderbolts, German resistance collapsed, the enthusiastic commander of 12th Brigade reporting that his casualties were the lightest for such an operation in his experience. Eighth Army was equally enthusiastic, describing "Timothy" as *'..the greatest step forward in air/ground cooperation since the innovation of the Rover controls.'*73

Meanwhile, similar attacks had been carried out in North-West Europe, where they were referred to as 'Winkle'. On October 1st 1944 No.84 Group RAF noted of 'Winkle', only recently introduced, that,

> *This type of operation involves the employment of aircraft in a very close support role, where the forward line of our own troops is identified by a line of white smoke extending for 1,000 yards, 2,000 yards, or 3,000 yards. This line of smoke clearly defines the area beyond which pilots are free to attack. Normally such an operation is laid on in connection with a ground offensive, with the object of destroying and disrupting the enemy's defences and reducing morale, in order to facilitate an immediate advance. On the one or two occasions when this method of support has been employed, success has been evident...In difficult country where it is not possible, or where it is very difficult, for ground O.P.s to locate exactly the position of mortars and defended posts, it is usually a somewhat haphazard procedure to attempt to indicate pinpoint targets by the use of red smoke. "WINKLE" is considered to be the better method in these circumstances, even though it may entail a certain waste of effort.74*

On October 20th 1944 Typhoons of No.84 Group carried out a particularly successful 'Winkle' on the

immediate front of the Canadian 2nd Infantry and 4th Armoured Divisions. This was in support of Operation SUITCASE, the attack towards Esschen as part of the advance to clear South Beveland in Holland. Some 59 sorties were flown by rocket-Typhoons and Typhoon bombers during the day, the Operations Record Book of No.263 Squadron recording that,

> *Bombing was good, nearly all falling on selected targets by the road side. A message was received later from Army H.Q. to say the attack was very successful as many enemy strongpoints had been wiped out, and they had been able to advance to within one mile of Esschen.*75

Further approbation was received from 10th Canadian Infantry Brigade, whose troops reported finding the bodies of 42 German troops killed during the 'WINKLE' on their front alone.76

By the end of the year a further variation had been introduced in Italy. On December 14th 1944 the First Canadian Division, advancing towards the River Senio, encountered stiff German oppostion in the area of the Naviglio Canal. A request was made to Desert Air Force for a 'Timothy', but weather conditions precluded bombing. Rather than leave the Canadians unsupported, Desert Air Force suggested a 'Timothy' without bombs, a strafing attack by three squadrons. In the afternoon infantry of the Westminster Regiment supported by tanks of Lord Strathcona's Horse attacked Northwards along the canal road, just ahead of them Spitfires

strafed the German positions on both side of the canal - this support being so close that spent cartridge cases from the Spitfires' guns fell among the Canadians. By evening the German positions had been cleared at the cost of 4 Canadians killed and 16 wounded, over 100 German prisoners being taken. Strafing 'Timothies' were afterwards referred to as 'Pigs'.77

The advantage of 'Timothies' and 'Winkles' was that the fighter-bombers could neutralize German positions to greater depth than the single belt of fire of an artillery barrage, and added the more pronounced morale effect of air attack. They also permitted greater flexibility in the advance. Even when, as a result of unexpected opposition, the advance did not conform to plan the fighter-bomber pilots could still directly support the infantry. The air attacks on 12th November in Italy were timed to coincide with the infantry advance, but in subsequent operations fighter-bombers attacked with equal success at pre-arranged intervals, irrespective of the line reached by the forward troops, the smoke safety line being put down to conform with the ground battle at any given time. The smoke line could also be put down diagonally to the axis of advance, and pilots were briefed for this eventuality. Moreover, particularly

troublesome strongpoints could be singled out for attack in the usual way through the FCP.78

As with CABRANK, such operations could be expensive of air effort. At least 260 sorties were flown in close support of 12th Brigade in Italy on November 12th & 13th 1944, albeit with only one aircraft being lost. Moreover, mass air attacks on generally defined areas instead of specific targets necessarily involved a certain waste of effort, with much of the bombing and strafing being directed at areas unoccupied by German troops. As employment of 'Timothies' became extensive, their advantages became negated by misuse. In 1945 Eighth Army reported of 'Timothy' that it was intended as air support for offensive operations, but that,

> *..it was...NOT always used as such, and there was a tendency for it to degenerate into a mere 'area blitz'.79*

Partly as a result of excessive caution and partly because in some formations the mechanics of 'Timothy' were insufficiently understood, the artillery smoke line was often put down between 500/800 yards ahead of the leading British troops. This was too far, and meant that the fighter-bombers did not attack the forward German positions, but instead, as German prisoners affirmed, bombed and strafed targets some 400 yards to the rear of the German front line. After reviewing a number of cases, First Canadian Corps

advocated that the smoke bombline be put down no further than 300 yards from the forward troops.80

The Fighter-Bomber/Artillery Combination.

Most close support strikes involved some form of artillery participation. Usually this took the passive form of indicating targets or the bombline to the aircraft but, when possible, guns had the more active role of assisting the aircraft by suppressing known German flak positions, airburst shells being effective in inducing flak gunners to remain in cover. Attaching an artillery FOO to the staff of an FCP also proved profitable, for this officer was on hand to engage a target rejected as unsuitable for air attack and, for those targets accepted for airstrike, could arrange smoke indication more rapidly. This led to combining programmes of air attack and artillery bombardment, such as shelling a target area a few minutes after an airstrike with the intention of catching the German troops just as they were emerging from cover.81

As time went on, a method of more direct artillery/fighter bomber cooperation evolved and, as with many air support innovations, it first appeared in Italy. At the height of the battle for Rimini in September 1944 it was found that the two FCP's working on the Eighth Army front (ROVER DAVID & ROVER PADDY)

could not cope with the number of targets submitted by Divisions and Brigades. Moreover, as many of these targets were German gun and mortar positions, it became imperative to ensure as far as possible that those attacked by fighter-bombers were those actually engaging the British troops. In effect, an improved method of passing accurate counter-battery data to the fighter-bomber pilots was necessary, requiring specialised artillery involvment.

The solution was the creation of an FCP entirely concerned with air attack on enemy guns - ROVER FRANK - situated at an AGRA headquarters where artillery counter-battery officers worked together with an RAF air controller. The AGRA furnished the FCP with a regularly updated list of active German battery positions, and when aircraft were given a target of German guns they were to check in with ROVER FRANK, who confirmed that those particular guns were still active. If they were, then the airstrike went ahead, but if not ROVER FRANK directed the strike upon an active battery. ROVER FRANK went into operation on September 18th, directing a series of airstrikes at 15 minute intervals which succeeded in reducing considerably the volume of fire from eleven German batteries firing on Canadian troops from the Trebbio-Marecchia valley.82

Fighter-bomber attack on German batteries proved effective, by suppressing German fire even if the guns themselves were not destroyed. Mediterranean Allied Air Forces ORS reported that,

> *During and after fighter-bomber attacks on enemy gun positions, the shelling activity of these guns is reduced; either because material damage has been caused, or firing has ceased during the attack, or because the battery attacked has moved to avoid further attack.*83

Precisely how effective such attacks were was discovered by an intensive ORS analysis of fighter-bomber support for British V Corps operations in Italy between October and December 1944. From this data, particularly regarding the level of casualties inflicted by German shellfire and by comparing the volume of this fire on days when fighter-bombers attacked the German guns with days when air support was reduced or unavailable, it was found that ten fighter-bomber attacks, amounting to some 50 sorties, directed against German gun positions during a day approximately halved their activity. When 100 fighter-bomber attacks, equivalent to some 500 sorties, were carried out 60-90 fewer British troops were killed and some 200-300 fewer wounded by German shellfire. The cost to the RAF of these 500 sorties, calculated under the operational conditions of the time, would have amounted to 2.6 pilots killed or missing, 0.3

pilots injured, and 4.5 aircraft lost in a total of some 600 flying hours.84

The saving of nearly 400 army casualties seems a fair return for such losses, but the necessary commitment of air effort, amounting to over one sortie per army casualty saved, was high. As with all the close air support methods discussed above, such commitment of air resources was possible only as a result of the Allied air forces possessing complete air superiority and having available large numbers of tactical aircraft. This aside, the figures suggest that German batteries were seriously disrupted by air attack.

In fact, there is evidence to suggest that air attack was considerably more effective than artillery counter-battery (CB) fire. In a comparison analogous to that between airstrikes and artillery concentrations in close support of attacks, it can be seen that neutralization achieved by artillery against German guns tended to be of shorter duration than that achieved by fighter-bombers. For example, after the capture of Boulogne in September 1944 an investigation by No.2 ORS observed of artillery CB that,

> *Discussion with Infantry and Artillery personnel served to confirm once more ...that while an accurate concentration on a well located battery invariably silenced it for the duration of the concentration, the effect seldom lasted for any length of time afterwards..*85

That this was realised at the time and acted upon is reflected in the setting up of ROVER FRANK in Italy, which was itself a reflection of the number of close support requests with German gun and mortar positions as their target. Indeed, one artillery specialist has recently observed of the campaigns in 1944-45 that aircraft came to assume the greater responsibility for counter-battery work, adopting the role carried out by heavy artillery in World War I and leaving field artillery to concentrate on the close-in battle.86

CONCLUSION.

This chapter appears to have highlighted a paradox. The Allied armies were well equipped with artillery which was able to provide fire support rapidly in response to requests from forward troops. They were also supported by fighter-bombers of the tactical air forces which normally could not respond to support requests with anything like the same speed without a considerable commitment of air resources to the battle area, and whose attacks offered little significant advantage over artillery in terms of destruction. Yet fighter-bomber attack appears to have been significantly more effective than artillery in terms

of neutralization, and the above examples from both Italy and North-West Europe indicate that against close support targets neutralization, albeit temporary, was just as important as destruction, indeed more so in view of the small likelihood of the latter being achieved.87

Fighter-bomber attack frequently proved to have a greater morale effect than that of artillery and, moreover, could cause this demoralization of the enemy more rapidly. This in turn was also likely to be of longer duration than that caused by artillery bombardment. The reason was partly the shock effect of the weight of firepower that fighter-bombers could deliver in a comparatively short space of time. In addition, the Allied ORS investigations suggest that, in general terms, being subjected to air attack was genuinely more frightening for troops than being subjected to artillery bombardment and induced a greater feeling of helplessness.

In this respect fighter-bomber close air support was invaluable for Allied troops about to attack German positions, but only if the assault troops were so placed as to take maximum advantage of the shock effect by attacking as soon after the airstrike as possible. While the shock effect of air attack may have been of longer duration than that caused by artillery, it was, as the ORS calculated, unlikely to

last beyond 20 minutes. Depending upon such variables as the nature and weight of air attack and the quality of the German troops and their level of protection, it could be considerably less. Very often it was not possible for the assault troops to take immediate advantage of airstrikes, even had it been planned that they should do so. A study of the message logs of British Army formations reveals numerous occasions when there was a considerable lapse of time between a requested airstrike and an attack going in.

The reason was what the Nineteenth Century military philosopher Carl von Clausewitz termed the 'friction' of war, the propensity of the unforseen to intervene to upset plans.[88] Battalions waiting to attack could be delayed by the fact that another battalion detailed to clear the area of their start line encountered unexpectedly heavy resistance. Armour support could be delayed in moving up due to road congestion or the presence of mines. Orders and timings could be changed at short notice due to circumstances beyond the knowledge and control of units detailed to attack; all these could occur with too little notice to alter air support timings, or even after the airstrike had been made. Occasionally the airstrike could go in at a time other than originally intended due to the threat of adverse weather closing in, yet it proved impossible for the army to speed up its own preparations.

Occasionally the fighter-bombers could inadvertently attack the wrong target. Often, particularly during major operations, there was no attempt to exploit the morale effect of many of the air attacks, fighter-bombers being directed to engage German positions in general 'softening-up' attacks not closely coordinated with specific ground assaults.

Under such conditions the value of close air support, that of neutralization, was wasted. The soldiers learnt how important it was to exploit airstrikes rapidly, yet they could hardly be expected to desist from requesting air support on occasions when it was known that such exploitation was neither possible nor intended. In 1943-45 Allied troops became accustomed to a lavish scale of air support, and the fact that it could be requested meant that it would be. During their joint investigation of Typhoons in 1945, ORS 2nd TAF and No.2 ORS observed that British and Canadian troops had become so dependent upon Typhoons that,

> *..when, for reasons not always obvious to the front line troops, a request for close support Typhoons has to be turned down, a feeling of dissatisfaction is apt to arise.*[89]

When close air support was not exploited on the battlefield the fighter-bombers may have been more profitably employed against targets beyond the battlefront. This is the subject of Chapter VIII.

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29. No.2 ORS/ORS RAF 2nd TAF Joint Report No.3 (1945), *Rocket Firing Typhoons in Close Support of Military Operations*, in *Operational Research in North West Europe*, PRO WO 291/1331.
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In Normandy, a team of investigators from No. 83 Group exanined the results of rocket-Typhoon attacks against German strongpoints in villages around Caen and at Carpiquet airfield. The village buildings were rugged rural dwellings with walls about 20 inches thick. The RAF team found that instantaneously fused rockets had blown holes up to 9 feet in diameter in these walls, but in the light of comments from Canadian and British infantry officers they reported that even direct hits were insufficient to render them untenable. Typhoons had also fired some 56 rockets at a Chateau strongpoint to the North West of Caen but the RAF team found evidence of only 12 effective hits, and no evidence that the defence had been impeded by the explosions or debris. At Carpiquet the Germans had fought tenaciously to hold the airfield. On July 4th during Operation WINDSOR, the attempt by 3rd Canadian Division to capture it, the Royal Winnipeg Rifles sustained 132 casualties in attacking German strongpoints which, later in the day, were rocketed by 44 Typhoons. Here the air attacks had been more effective; the airfield buildings had brick walls some two feet thick, but rocket hits had sprayed their interiors with lethal splinters of stone and steel. No.83 Group concluded that a much increased scale of air attack was necessary to achieve adequate levels of destruction. The usual practice of attacking village strongpoints with totals of 60-100 rockets (8-12 Typhoons) was inadequate, and they suggested that the scale of attack be such to ensure that each house was hit by four rockets. Attacks against isolated strongpoint buildings, such as the Chateau, required saturation by at least 120 rockets (15 Typhoons). Appendix C to No.83 Group Operations Record Book (1944), *Effect of R.P. Attack Against Villages (Strong Points)*, PRO AIR 25/704. Canadian losses from C.P. Stacey, *The Victory Campaign* (Ottawa; 1960).
Similar conclusions were reached by Allied ORS investigating close air support in the Far East. In 1945 a report compiled by the USAAF operating in support of British Fourteenth Army in Burma noted that;

> *High percentages of casualties can be achieved only by higher concentration of bombs on the target than are obtainable with the normal strikes (of a squadron or fewer of fighter-bombers). When the enemy can be contained in the target area for a considerable period of time (i.e. long enough for several such strikes on the same positions), the effects of such strikes are cumulative. Killing more than 5-10% of the enemy in a position is, therefore, normally something that can be achieved by fighter bombers only in a static battle, or a very slowly moving one.*

US Army Air Forces, India Burma Theater, (2nd June 1945), *The Effectiveness of Air Strikes as carried out by 221 Group in Co-Operation with Fourteenth Army*, PRO AIR 23/4359.
36. No.2 ORS/ORS RAF 2nd TAF Joint Report No.3 op.cit.
37. Ibid.
38. US 12th Army Group Battle Experiences No.62, (9th October 1944), quoted in British Army Operational Research Group Report No.282, op.cit.
39. No.1 ORS British Army, Report (February 1944), *Bombardment To Break Morale*, PRO WO 291/1327.
40. No.1 ORS British Army Report No.1/24 (1944), *Effects of Artillery Fire - Italy*, PRO WO 291/1317.
41. See Chapter III.
42. No.1 ORS British Army, *Bombardment To Break Morale*.
43. British Army Report (1944), *The Probability of Hitting Targets with Artillery Fire*, PRO WO 291/1330.

44. General Patton to General Campbell, quoted in Roby Vattisuom, *Present and Future Artillery Fuzes*, in *Defence Today*, No.87-88 (August 1985), pp.311-316.
45. British Army Battle Analysis Study (1945), *Role of Rockets as Artillery Weapons, 1944-45*, PRO WO 232/49.
46. No.2 ORS Report No.26 (1945), *Fire Support in Operation Veritable*, to be found in No.2 ORS *Operational Research in North West Europe*.
47. Prisoner of War Interrogation Report, ADI (K) Report No.382/1944, (24th July 1944), PRO AIR 37/760.
With conditions and theatres of war this varied. Japanese troops in bunker positions had little to fear from strafing. A captured Japanese Intelligence Officer questioned on the effects of air attack stated that troops were nervous of bomb hits but that when strafing started, which usually followed bombing, it was time to relax and 'light up cigarettes'. No.10 ORS (Fourteenth Army) Report (March 1945), *Interrogation Of A Japanese Officer*, PRO AIR 23/2829.
48. US XIX Corps, quoted in The AAF Evaluation Board in the ETO, *The Effectiveness of Third Phase Tactical Air Operations*.
49. Ibid., p.230.
50. ORS US 9th Air Force, (9th February 1945), *Use and Effectiveness of Napalm Fire Bomb*, PRO AIR 37/956.
51. Ibid.
52. No.2 ORS/ORS RAF 2nd TAF Joint Report No.3, op.cit.
53. Ibid. German troops may had heard rumours of casualties and damage caused by Typhoon rocket attacks against troops and motor transport caught in the open, when casualties would have been greater.
54. No.1 ORS British Army Report No.1/24, op.cit.
55. No.2 ORS/ORS RAF 2nd TAF Joint Report No.3, op.cit.
56. Ibid.
57. US 90th & 9th Infantry Divisions, quoted in The AAF Evaluation Board in the ETO, *The Effectiveness of Third Phase Tactical Air Operations*, p. 231.
58. Ibid, quoting US VIII Corps.
59. Jeffery Williams, *The Long Left Flank*, (London: Leo Cooper, 1988), pp.131-132.
60. Bailey, op.cit., p.205.
61. Bradley & 12th Army Group Air Effects Committee, op.cit.
In a post war USAAF analysis the US XVI Corps stated of close air support strikes against fortified villages and strongpoints within artillery range that, *'The desired results in many cases can be obtained more quickly and effectively by air.'*
Quoted in The AAF Evaluation Board in the ETO, *The Effectiveness of Third Phase Tactical Air Operations*, PRO AIR 40/1111.
62. Incident related by Jeffery Williams in letter to I.R. Gooderson, February 19th, 1990.
63. No.2 ORS Report No.22, *The Effect of Artillery Fire on Enemy Forward Defensive Positions in the Attack on Geilenkirchen*, in *Operational Research In North-West Europe*.
64. Ibid.; War Diary, 5th Dorsetshire Regiment, November 1944, PRO WO 171/1287
65. No.2 ORS Report No.22, op.cit.
66. No.2 ORS Report No.26, op.cit.

67. Pemberton, op.cit., p.267.
Over 3,000 guns were assembled for the crossing of the Rhine in March 1945. One regiment alone during this operation, the 13th Royal Horse Artillery, on March 23rd fired without cease for 10 hours, and by just over 15 hours had fired 16,800 rounds of high-explosive. Brookes, op.cit., p.221.
Such colossal expenditure of ammunition resulted in periods of artillery famine either through shortage or because rounds were being conserved for a major assault. In Italy before the assault on the GUSTAV LINE in May 1944, for which 1,060 guns were assembled, the British 25-pounders were restricted to 15 rounds per gun per day and the medium guns only 10 rounds per day. Pemberton, op.cit, pp. 212-213.
John Ellis points out that Allied artillery expenditure in 1944-45 was on a par with World War I. In North West Europe alone US artillery fired some 48 million rounds, equivalent to 25.6% of the 187 million rounds fired by the British Armies on the Western Front between September 1914 and November 1918. See *Brute Force: Allied Strategy and Tactics in the Second World War,* (London: André Deutsch, 1990), p. 536.
68. Pemberton, op.cit., p.235.
69. Ibid. But experience showed that an increasing use of 'on call' targets instead of timed programmes brought occasions when the infantry found it difficult to decide when and where to call down fire support. When command was not centralized, there was the risk that one unit by calling for fire support might bring down fire onto another that had advanced further. In the event of communications failure, the absence of a timed programme could result in no artillery support at all.
70. I.S.O. Playfair & C.J.C Molony, *The Mediterranean and Middle East,* Volume IV, (London: HMSO, 1966), pp. 344-350.
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81. Ibid.
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84. Ibid.
85. No.2 ORS Report No.16, op.cit.
86. Bailey, op.cit., p.197.

87. By 1945 artillery tactics in North-West Europe emphasised neutralization, with many favouring the development of longer range guns with a lighter (20-lb) shell. But gunners in the Far East were disdainful of neutralization, having learnt that the only way to deal with formidable Japanese field defences was to destroy them and their occupants. See Bailey, op.cit., p.230, and Pemberton, op.cit., p.320.
An emphasis on destruction can also be discerned in the records of Allied tactical air forces in the Far East, and much work was done by RAF ORS Air Command South East Asia and by the RAF's Jungle Targets Research Unit in attempts to determine the most effective method of destroying Japanese bunker positions and fieldworks from the air. Their papers are in the PRO AIR 23 files.

88. Carl von Clausewitz, *On War*, (Harmondsworth: Penquin, 1986), pp.164-165.
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CHAPTER VIII.

THE COST EFFECTIVENESS OF CLOSE AIR SUPPORT: A COMPARISON WITH ARMED RECONNAISSANCE

Introduction.

The object of this chapter is to provide a comparative analysis of the single most important alternative ground attack mission to close air support. The alternative mission, rivalling close air support in terms of the committment of Allied fighter-bomber effort in 1943-45, was armed reconnaissance. There are two dimensions to the following discussion, cost and effectiveness, and the chapter seeks to reveal which of the two mission types incurred the heaviest losses in aircraft and pilots, and to determine precisely what the Allied fighter-bombers achieved when directed against ground targets other than in the close air support role.

I. THE ALTERNATIVE MISSION: ARMED RECONNAISSANCE.

Definition.

In 1944 RAF Desert Air Force in Italy described armed reconnaissance (usually abbreviated to armed recce in contemporary documents) thus:

> *Pilots are given a general area, usually well behind the enemy lines, in which to find and attack with bombs and machine-gun fire, any target of tactical value. They use their own discretion and initiative as to the targets they select for attack. These targets include...M.T.* [motor transport], *bridges, camps and barracks, trains, defence works, airfields, ships or barges and fuel dumps..* 1

This was a highly offensive use of tactical air power, but that there was an element of reconnaissance involved was confirmed by RAF 2nd TAF which reported of armed reconnaissance in 1945 that

> *..fighter aircraft are sent out to look for ground targets and attack them. At the same time, pilots bring back any possible information about the enemy ground situation.* 2

While the impact of close air support was felt at the battlefront, that of armed reconnaissance was felt sometimes far behind it, as fighter-bombers brought the German rear areas and lines of communications under attack. This was in fact interdiction, even when not part of a deliberate interdiction campaign, and was in effect a continual air offensive demanding a consistently large commitment of sorties.

Extent of Armed Reconnaissance.

In North-West Europe, more sorties were flown on armed reconnaissance than on close support by the Allied tactical air forces. Table I gives a breakdown of the total sorties flown by RAF 2nd TAF during the campaign according to mission type:

TABLE I. SORTIES BY RAF 2nd T.A.F. 1944-45

Percentages of total missions for month given in brackets.

MONTH	MEDIUM/LIGHT BOMBING	FIGHTER ESCORT & PATROLS	FIGHTER-BOMBER PREARRANGED & IMMEDIATE SUPPORT	ARMED RECCE	RECCE	TOTAL SORTIES
June'44	3,117 (8.2%)	18,062 (47.6%)	7,652 (20.1%)	5,277 (13.9%)	3,810 (10%)	37,918
July'44	3,304 (10%)	14,528 (44.2%)	6,484 (19.7%)	5,527 (16.8%)	3,025 (9.2%)	32,868
Aug.'44	3,990 (11.9%)	7,325 (22%)	3,850 (11.5%)	14,169 (42.6%)	3,918 (11.7%)	33,252
Sept.'44	2,543 (11.6%)	6,289 (28.8%)	3,724 (17%)	6,851 (31.3%)	2,428 (11.1%)	21,835
Oct.'44	1,615 (6.7%)	5,659 (23.5%)	5,530 (23%)	8,544 (35.5%)	2,688 (11.1%)	24,036
Nov.'44	1,759 (10.7%)	3,525 (21.5%)	5,027 (30.6%)	3,830 (23.3%)	2,237 (13.6%)	16,378
Dec.'44	1,907 (12.9%)	5,036 (34.1%)	2,490 (16.8%)	3,362 (22.8%)	1,950 (13.2%)	14,745
Jan.'45	1,800 (15.4%)	2,538 (21.7%)	2,032 (17.4%)	3,995 (34.2%)	1,293 (11%)	11,658
Feb.'45	2,998 (15.4%)	2,178 (11.2%)	6,160 (31.7%)	5,988 (30.8%)	2,104 (10.8%)	19,428
March'45	4,071 (15.7%)	9,259 (35.7%)	4,961 (19.1%)	4,683 (18%)	2,901 (11.2%)	25,875
April'45	2,957 (10.3%)	6,558 (22.8%)	5,065 (17.6%)	11,183 (39%)	2,883 (10%)	28,646
TOTALS:	30,061 (11.2%)	80,957 (30.3%)	52,975 (19.8%)	73,406 (27.3%)	29,237 (10.9%)	266,639

Although the sorties by all types of aircraft are included for comparison, the three relevant columns are those concerning fighter/fighter-bomber aircraft, as neither light and medium bombers nor specific reconnaissance aircraft flew armed reconnaissance. From these three columns it can be calculated that, during the eleven month campaign, some 10% more sorties were flown on armed reconnaissance than on close support. 3

A predominance of armed reconnaissance sorties can also be seen in the operations of the US tactical air forces in this theatre. Between October 1943 and May 1945 fighters of the US Ninth Air Force flew 73,123 armed reconnaissance sorties while those committed to 'dive bombing' and 'rocket projecting and bombing', which embraced close support, amounted to a combined total of 55,983 sorties - a striking similarity to the corresponding 2nd TAF totals.14 Close support apparently took second place to armed reconnaissance in the operations of the 1st US (Provisional) TAF between November 1944 and May 1945. In this period the P-47 Thunderbolt squadrons of this formation flew 14,479 armed reconnaissance sorties, as opposed to 5,563 sorties listed as 'ground support'.5

Armed reconnaissance also accounted for a high percentage of sorties during the campaigns in Sicily and Italy. However, with regard to the Mediterranean

theatre it is difficult to determine precisely the balance between close air support and armed reconnaissance because Mediterranean Allied Air Force (MAAF) did not employ these terms. This problem has been pointed out by American historian Alan Wilt, who observes that during the campaign in Sicily tactical sorties by fighters were either listed as 'offensive sweeps' or 'ground attacks'. Thus between July 9th and August 17th 1943 some 4,000 Allied fighters flew 45,173 sorties of which 13,309 were listed in these categories, Alan Wilt observing that,

> *..from what is known from memoirs and other sources, most of the sweeps and attacks reflected interdiction missions and not close air support.*

During the period of the offensive on Rome (Operation DIADEM) from May 12th to June 22nd 1944, MAAF categorised fighter tactical operations as either 'fighter-bomber' or 'strafing and sweep' missions. Of the 32,291 such sorties flown during this period, Professor Wilt estimates that about half were directed against interdiction targets, with the other half, or 24% of the DIADEM total, being in close air support. 6

II. COMPARATIVE LOSSES.

The attrition rate of pilots and aircraft among fighter-bomber squadrons engaged in attacking ground targets during 1943-45 was high. Bill Colgan, a former P-47 Thunderbolt pilot who served with the US 79th Fighter Group in Italy, wrote of the period May-June 1944 that,

> *If the damage inflicted upon the enemy had been great, never before had our squadron and one other in the Group suffered such losses..The loss rate in May was such that if it continued over a period of months, the entire pilot force in these squadrons would have to be replaced about every three to four months.* 7

Similarly, a Typhoon pilot who served with the RAF in North-West Europe recalled of the Autumn of 1944 that,

> *The average survival rate for a rocket-Typhoon pilot since mass missions at low level were introduced is around 17 ops. After that, he lives on borrowed time. Veterans stand a better chance of living than the younger ones, whose average number of ops before 'buying it' is no more than five.* 8

In fact the hazardous nature of low-level attack was acknowledged by the RAF in December 1944, when the tour of duty for such pilots was reduced from the normal fighter pilot tour of 200 operational sorties to 80 - a reduction of no less than 60%. 9

Flak.

The scourge of Allied fighter-bombers was flak. From the point of view of the Allied tactical air forces, the most unwelcome consequence of the German armies having to adapt to operating in the face of Allied air superiority was the great increase by 1943-44 in the amount of light automatic anti-aircraft firepower possessed by German formations. An infantry division was typically equipped with at least eighty-four 20mm light anti-aircraft guns, while a panzer division of the type encountered in Normandy was equipped at full strength with up to 21 self-propelled, 55 towed, and 32 lorry or half-track mounted anti-aircraft guns - mostly of 20mm and 37mm calibre with a high rate of fire. In both cases this was in addition to hundreds of lighter calibre machine guns and small-arms that could engage low flying aircraft.10 Table II lists the principal German flak guns and their characteristics.

TABLE II. GERMAN LIGHT ANTI-AIRCRAFT ARTILLERY (11)

TYPE	MAXIMUM ELEVATION (DEGREES)	RATE OF FIRE (rds/min)	MAXIMUM VERTICAL RANGE (FEET)
20mm Flak 30	90	280	7,000
20mm Flak 38	90	450	7,000
20mm Flakvierling	100	1800 *	7,000
30mm Flak 103	80	400	15,400
37mm Flak 18	85	160	15,700
37mm Flak 36	85	160	15,700
37mm Flak 43	90	250	15,700
37mm Flakzwilling	90	500 **	15,700

* four-barrelled ** two-barrelled

Fighter-bomber pilots thus had to contend with a highly dangerous low-attack environment. This is emphasised by the former Typhoon pilot quoted above, who states with regard to Normandy that,

> *..the Germans had undisputed flak supremacy. It was estimated to be about 20,000 batteries of anti-aircraft guns, ranging from 105, 88, 40, 37 to 20mm, and not counting the numerous heavy machine-gun sites. Hence, the odds in favour of the enemy stood at 4 to 1 against the number of Allied aircraft. When concentrated on some key points of the battlefront, the odds easily reached 20 or 30 to 1 in favour of the defenders: this explains why up to 95 per cent of our losses in attacks on ground targets were the result of flak defences against a mere 5 per cent attributed to Luftwaffe intervention.* 12

While aircraft such as the Typhoon and Thunderbolt were rugged, they could not normally be expected to survive a direct flak hit, especially of the 37mm variety. As Bill Colgan points out,

> *While we had seen automatic flak listed from 15mm to 37mm, some of us still talked in terms of 20mm to 40mm sizes. Any of them could easily do a fighter-bomber in with a good hit.* 13

The likelihood of receiving such a hit was high, particularly when flak was concentrated to defend a particular target, as gunners could lay a curtain of fire through which the aircraft had to fly in order to press home their attacks. A former Typhoon pilot recalled that,

> *..the Germans would put up a carpet of 20 and 40mm stuff. Little white puffs you could get out and walk on. Round about 3-4,000 feet this was and one had to dive through it.* 14

The lethality of light flak was confirmed by ORS 2nd TAF during an investigation into squadron damage reports in July 1945. This concluded that,

> *..practically all the damage sustained on operations due to enemy action was caused by light flak.*15

Further proof came in another post-war investigation, which discovered that many of the fighters posted as missing on operations were likely to have been light flak victims. On repatriation to the UK fighter pilots who had been prisoners of war were interviewed by ORS personnel as to the cause of their aircraft loss. This included pilots who had not been engaged in ground attack, and covered the entire 1940-45 period. From a total of 1,002 cases, of which 672 (67%) occurred in the period 1943-45, a sample of 770 were selected for analysis. Of these, 369 (47.9%) had been light flak victims (most of which were in the 1943-45 period), 335 (43.5%) had been air combat victims, while the remaining 66 (8.5%) were attributed to 'unknown flak'.16

Fighter-Bomber Losses.

There is conclusive evidence that armed reconnaissance was more dangerous than close air support. In 1945 ORS 2nd TAF compared the close support and armed

reconnaissance operations of Nos. 83 and 84 Groups between January and April 1945. The results for the period January 22nd to March 21st are shown in Table III, while the figures for April are shown in Table IV, (though in this case comparing armed reconnaissance with close air support and fighter patrol duties put together).17

TABLE III, ARMED RECCE & CLOSE SUPPORT MISSIONS OF NOS,83 & 84 GROUPS, JANUARY-MARCH 1945

		No,83 GROUP	No,84 GROUP	TOTALS
Sorties In Period;		9,825	9,221	19,046
Casualties;		110	52	162
Sorties Per Battle Casualty;		89,3	177,3	117,6
SORTIES PER BATTLE CASUALTY:-				
TYPHOONS;	Armed Recce	76,8	126,2	
	Close Support	143,2	248,3	
SPITFIRES;	Armed Recce	94,2	135	
	Close Support	181,4	193,1	
TEMPESTS;	Armed Recce	57,1	36	
	Close Support	2,7	-	

TABLE IV. ARMED RECCE, CLOSE SUPPORT & FIGHTER PATROL MISSIONS OF RAF 2nd T.A.F., APRIL 1945

	No.83 GROUP				No.84 GROUP			
	Spitfire	Typhoon	Tempest	Total	Spitfire	Typhoon	Tempest	Total
Armed Recce Sorties	3,153	1,350	940	5,443	3,461	976	865	5,302
Close Support & Fighter Sorties	4,560	2,304	529	7,393	1,847	1,505	135	3,489
AIRCRAFT DESTROYED/ PILOTS LOST:-								
Armed Recce Missions	35/24	27/26	21/19	83/69	34/29	22/20	12/11	68/60
Close Support & Fighter Patrols	14/10	12/11	7/6	33/27	9/6	11/10	2/2	22/18

These figures represent a period in the campaign when, operating over German soil, pilots found flak highly concentrated. Squadrons flying armed reconnaissance, searching for targets, often paid a heavy price. Pierre Clostermann, a Frenchman serving in the RAF, led a Tempest wing of No.83 Group at this time which was employed mainly on armed reconnaissance. He later recalled that,

> *Germany seemed just lousy with flak. It was everywhere, even in the most unexpected places. You sometimes hit upon a peaceful country lane with a few lorries trundling along, you made your approach and whoof! the sky was full of 20mm tracer.*
>
> *German road convoys now had to stick to roundabout routes, which had been carefully worked out in advance and were covered for the whole of their length by light-flak batteries. The game was no longer worth the candle - there was no point in stupidly risking a Tempest for the fun of merely pulverizing one Wehrmacht lorry.* 18

German airfields were also armed reconnaissance targets, but by this time the remaining German operational fighters were harrying Allied troops from heavily camouflaged

secondary airstrips. These were protected by up to a battalion of light flak guns, often enabling the German aircraft to take off and land under a curtain of protective fire. Attempts to bomb and strafe these airfields could be extremely costly, and Clostermann records leading such an attack on the airfield at Schwerin in April 1945 which resulted in six of the eight attacking Tempests being shot down. 19 Not surprisingly, awareness of flak came to dominate the lives of pilots engaged on such missions, and Clostermann recalls that,

> *Flak was looming ever larger on my pilots' mental horizon. You could sense how it obsessed them in every conversation, at meals, at the bar, during briefings. To be convinced you had only to watch how sharply those who came back from a trip were questioned as to how dense the flak was, and where the posts were, by those who were about to set off. The word was on everybody's lips, all the time.* 20

That it was armed reconnaissance, and attacks on specific targets beyond the battlefront, rather than close air support that exposed pilots to the fiercest flak concentrations is reflected in the losses outlined in the above tables. An indication of the level of casualties sustained on close support strikes during this same period is shown in Table VII, which lists a number of operations by British and Canadian troops to capture defended towns or villages and the air support provided. 21

TABLE V. CLOSE AIR SUPPORT OPERATIONS, APRIL 1945.

DATE	OBJECTIVE	BRITISH ARMY FORMATION	LEVEL OF AIR SUPPORT	AIR LOSSES
2/4/45	Nijmegen Island	49 (West Riding) Div.	31 Typhoon sorties	none
8/4/45	Voltlage	52 (Lowland) Div.	4 Typhoon sorties	none
10/4/45	Deventer	3 (Cdn) Inf. Div.	27 Typhoon sorties	none
11/4/45	Rethem	53 (Welsh) Div.	22 Typhoon sorties	none
12/4/45	Arnhem	49 (West Riding) Div.	131 Typhoon & Spitbomber sorties	none
12/4/45	Friesoythe	4 (Cdn) Armd. Div.	32 Typhoon sorties	1 Typhoon lost pilot baled out
13/4/45	Altenwahlingen	53 (Welsh) Div.	4 Typhoon sorties	none
14/4/45	Winsen	11 Armd. Div.	12 Typhoon sorties	none
17/4/45	Eitze	53 (Welsh) Div.	8 Typhoon sorties	none
24-25/4/45	Bremen	3 Inf. Div.	25 Typhoon sorties	none

The principal reason for the difference in casualties is that, as the above quotes indicate, flak was concentrated to defend such typical armed reconnaissance targets as airfields, headquarters, supply dumps, and vital points in the communications network. In the front line, except in support of heavily defended key positions, flak was likely to be far less concentrated and flying against such close support targets as small defended posts, pillboxes, and gun positions which were often well dispersed, there was considerably less. Moreover, during close support strikes friendly artillery was often on hand to suppress flak. Armed reconnaissance pilots were denied this help, though strikes against heavily defended targets could be

supported by additional aircraft - often rocket Typhoons - specifically tasked with flak suppression.

These anti-flak Typhoons usually operated in pairs, one pair drawing German fire while another pair spotted for gun flashes and dived to attack. Guns opening fire on the second pair were then rocketed by a third pair of Typhoons orbiting the area. This was in itself very hazardous, for while flak gunners were often shy of artillery fire they were rarely afraid of air attack. A former Typhoon pilot recalls of such attacks that,

> *The German gunners were generally very courageous; they'd continue firing at you as you were coming straight down at them. You knew you were going to get them and they knew it too, but they'd keep on firing. There is no doubt that the standard of the opposition was very high.* 22

In fact the high quality of German flak gunners was acknowledged at the time by No.2 ORS, who observed after the capture of Calais (Operation UNDERGO) in September 1944 that the morale of the Luftwaffe flak gunners was the highest among the entire garrison.23

Apart from the anti-flak aircraft being themselves at risk, and their presence representing a greater demand on air resources, they were not always effective even when employed in large numbers. This was seen especially during the crossing of the Rhine in March 1945, when both Nos.83 and 84 Groups maintained strong anti-flak patrols by Typhoons equipped with rockets and anti-personnel cluster bombs in the area of the Allied airborne landing.

Subsequent investigation by No.2 ORS discovered that not only had very few of the flak guns been destroyed - which was no surprise as by then the problem of accuracy was well known - but also that there had been no appreciable slackening of the flak fire during the airborne drop. This was considered to be because there were not enough Typhoons available to maintain the constant attacks deemed necessary to effect neutralization, and the fact that they obviously could not operate during the drop itself.24

An important question with regard to the above data is whether the comparative close air support and armed reconnaissance casualties from early 1945 are representative of the campaign in North-West Europe as a whole. While there is no ORS data similar to that of 1945 for earlier in the campaign, the available evidence does suggest that armed reconnaissance was consistently more costly. Table VI is based on the Daily Intelligence Summaries produced by No.83 Group of 2nd TAF for the period August 1944 until February 1945 and which detail each day's operations in terms of sorties per mission type and also battle casualties. Although it is not specified on what type of operation each casualty was sustained, these statistics show that the number of aircraft casualties in a given number of sorties was greatest during those months when most sorties were flown on armed reconnaissance.25

TABLE VI. No.83 GROUP (RAF 2nd TAF) ARMED RECCE & CLOSE SUPPORT EFFORT AUGUST 1944-FEBRUARY 1945

	IMMEDIATE & PREARRANGED SUPPORT SORTIES	ARMED RECONNAISSANCE SORTIES	AIRCRAFT CASUALTIES*	SORTIES PER CASUALTY
August 1944	4,538	8,516	103	126.7
September 1944	1,471	2,344	51	75.5
October 1944	3,026	1,861	34	143.7
November 1944	2,285	1,315	36	100.0
December 1944	967	2,298	66	49.4
January 1945	639	3,709	55	79.0
February 1945	2,231	4,152	70	91.1

* Computed on aircraft destroyed or damaged, not on pilots. Does not include casualties sustained in combat with enemy aircaft or those not due to enemy action. The majority of the above casualties were listed as caused by flak.

The same trend can be discerned in US tactical air operations during the campaign. Table VII shows the number of sorties by mission type each month between November 1944 and April 1945 for the P-47 squadrons of the US 1st (Provisional) TAF, while Table VIII gives their losses for each month. This shows that, during the two months when the most armed reconnaissance sorties were flown, March and April 1945, the number of aircraft lost to flak and to 'unknown causes' (presumably on deep armed reconnaissance missions beyond the German front line) was considerably greater.26

TABLE VII. P-47 SORTIES, 1st US (PROVISIONAL) TAF NOVEMBER 1944-APRIL 1945

	DIVE BOMBING	ARMED RECCE	GROUND SUPPORT	FIGHTER SWEEPS	ESCORT	MISCELLANEOUS*
Nov '44	1,905	250	415	20	520	15
Dec '44	2,345	2,030	311	54	400	120
Jan '45	2,211	673	1,291	153	222	29
Feb '45	4,656	1,191	674	117	468	39
Mar '45	5,185	4,436	1,586	516	653	496
Apr '45	3,127	5,575	958	388	1,064	843

* Refers to leaflet dropping, weather reconnaissance, and patrols.

TABLE VIII. LOSSES OF P-47s OF US 1st (PROVISIONAL) TAF NOVEMBER 1944-APRIL 1945

LOSSES DUE TO:	FLAK	FLAK & ENEMY AIRCRAFT	ENEMY AIRCRAFT	ACCIDENT	UNKNOWN	TOTALS
November 1944	6	1	6	0	7	20
December 1944	9	0	11	5	19	44
January 1945	8	0	12	1	8	29
February 1945	11	1	0	3	20	35
March 1945	33	0	1	10	25	69
April 1945	33	0	7	9	22	71

A more detailed picture can be obtained by a study of losses at squadron level. Table IX shows the losses sustained throughout the campaign in North-West Europe by No.609 (West Riding) Squadron. This Typhoon fighter-bomber unit served throughout the campaign in No.84 Group of RAF 2nd TAF, being employed almost entirely in the ground attack role. Only losses sustained as a result of enemy action have been included, and all such losses, with one possible exception, were caused by flak. Aircraft that sustained flak damage but which were able to return to base have not been included. Armed reconnaissance and attacks beyond the battlefront against specific targets (such as headquarters, radar sites, and bridges) have been

compared with close air support. The experience of 609 Squadron confirms that attacks beyond the battlefront were more dangerous, with seventeen of the twenty-four aircraft and pilots lost, or 70%, being sustained on such operations. A sorties per battle casualty ratio shows 170.2 sorties per close support casualty and 102.1 sorties per armed reconnaissance/deep penetration casualty:

TABLE IX. LOSSES SUSTAINED ON OPERATIONS BY No.609 (TYPHOON) SQUADRON, JUNE 1944 - MAY 1945

	CLOSE AIR SUPPORT (Most strikes under VCP/FCP control)		ARMED RECCE AND ATTACKS ON TARGETS BEYOND BATTLEFRONT	
	SORTIES	LOSSES	SORTIES	LOSSES
June 1944	50	-	231	3
July 1944	183	3	86	2
Aug. 1944	80	1	366	5
Sep. 1944	63	-	211	1
Oct. 1944	247	-	57	-
Nov. 1944	117	-	147	1
Dec. 1944	8	-	169	1
Jan. 1945	4	-	56	-
Feb. 1945	152	2	71	1
Mar. 1945	79	-	180	1
Apr. 1945	209	1	140	2
May 1945	-	-	23	-
TOTALS:	1,192	7	1,737	17

TOTAL SORTIES: 2,929 TOTAL LOSSES (AIRCRAFT AND PILOTS): 24 *

* Includes four pilots that subsequently returned to the Squadron after baling out or force-landing in Allied territory.

Of the total of twenty-four pilots lost, thirteen (54%) had carried out less than twenty operations by the time that they were shot down. Seven pilots (29%) had carried

out over thirty operations, and of these only three pilots (12%) had carried out over fifty operations. This tends to confirm Charles Demoulin's assertion, quoted above, that the less experienced pilots were most at risk.27

All the above evidence suggests that the further fighter-bombers operated beyond the battlefront, the higher their losses were likely to be. Confirmation of this was provided by ORS 2nd TAF in 1945 during an investigation into armed reconnaissance. While not directly relevant to a comparison with close air support, the results are worth noting because they proved that armed reconnaissance itself could be more dangerous depending on how deep behind the German lines the aircraft patrolled. In February 1945 No.83 Group's armed reconnaissance effort was seen to be conveniently divided into two sections, deep and shallow penetration, the areas being separated by a line some 60 miles behind the German lines running through Hamm, Munster, Rheine, Almelo, and Zwolle. This provided an ideal opportunity for comparison, and the ORS findings are summarised in Table X. While the table does not indicate a significant increase in the risk from flak to pilots flying deep penetration missions, it is likely that the higher number of losses due to 'unknown cause' in this category reflects flak losses.

TABLE X. No.83 GROUP ARMED RECONNAISSANCE EFFORT FEBRUARY 1945.

	TOTALS		PER 100 SORTIES		PER AIRCRAFT LOST	
	Deep	Shallow	Deep	Shallow	Deep	Shallow
No. of Sorties	2,210	1,878	100	100	48	75,1
LOSSES						
Total	46	25	2,1	1,3	-	-
Due to enemy a/c	5	0	0,2	0	-	-
Due to Flak	15	11	0,7	0,6	-	-
Not due to enemy action	11	9	0,5	0,5	-	-
Unknown Cause	15	5	0,7	0,3	-	-

At the time the justification for such deep penetration missions was considered to be that pilots were presented with more targets and, judging by their claims, inflicted more damage. This is shown in Table XI:

TABLE XI. No.83 GROUP ARMED RECONNAISSANCE CLAIMS FEBRUARY 1945.

	TOTALS		PER 100 SORTIES		PER AIRCRAFT LOST	
	Deep	Shallow	Deep	Shallow	Deep	Shallow
No. of Sorties	2,210	1,878	100	100	48	75,1
CLAIMS						
Enemy aircraft *	32;3;33	17;0;8	1,4;0,1;1,5	0,9;0;0,4	0,7;0,1;0,7	0,7;0;0,3
Locomotives; ƒ	124;598	37;105	5,6;27,1	2,0;5,6	2,7;13,0	1,6;4,2
Trucks ƒ	198;1140	215;534	9,0;51,6	11,5;28,4	4,1;24,6	8,6;21,5
Motor Transport ƒ	135;505	120;321	6,1;22,9	6,4;17,1	2,9;10,9	4,8;12,8
Tugs & Barges ƒ	15;120	14;41	0,7;5,4	0,8;2,2	0,3;2,6	0,6;1,6
Rail Cuts	12	19	0,5	1,0	0,3	0,8

* Figures indicate destroyed;probably destroyed;damaged
ƒ Figures indicate destroyed;damaged

Nevertheless, the findings of this investigation resulted in 2nd TAF curtailing the number of deep penetration missions, and increasing the number of aircraft when such missions were flown. 28

III. THE IMPACT OF ARMED RECONNAISSANCE.

Having established that armed reconnaissance accounted for more sorties than close air support, and that it was the more dangerous ground attack mission, the object of this section is to consider the extent to which it assisted the Allied armies. There is no scope here for a detailed case by case analysis of armed reconnaissance such has been offered with regard to close air support, and which the subject merits. Rather, the following is intended to outline what armed reconnaissance achieved by drawing a parallel with close air support.

Relative Objectives.

Close air support was, in each instance, firepower applied at the decisive time and place in order to enable friendly troops to achieve set objectives - to

take a village, clear a wood, or repel a counter-attack. Like artillery, it was used as and when necessary to achieve short-term ends. As the previous chapters show, its success usually depended upon its effects being rapidly exploited on the ground.

In contrast, armed reconnaissance was continuous, for only by the exertion of constant pressure could it bring results. Its objectives, and its effects, were usually of a longer term nature.

Interdiction.

Armed reconnaissance by fighter-bombers was but one aspect of air interdiction, as a post-war US study observed:

> *All types of aircraft have played a part in interdiction: reconnaissance planes through surveillance and bomb damage assessment; fighter bombers on armed reconnaissance patrols, mediums and heavies by obstruction of the arteries of movement and destruction of the things to be moved.* 29

When the object of armed reconnaissance was, as part of a concerted air offensive, completely to cut off the German front line forces from reinforcement and supply, it was unsuccessful. A good case study to illustrate this is Operation STRANGLE, a deliberate interdiction campaign waged over two months by the Allied tactical, strategic, and coastal air forces in an attempt to paralyse the supply and transportation

system in Northern and Central Italy in the Spring of 1944. STRANGLE was intended to compel the withdrawal of the German armies from Central Italy in the period while the Allied armies were preparing a major offensive (DIADEM), and commenced on March 15th. Over 50,000 sorties were flown and 26,000 tons of bombs delivered.30 Yet, despite the destruction and disruption of many Italian road, rail and port facilities, the German armies continued to receive sufficient supplies - in fact those of ammunition and fuel actually increased in the period.31

When it was realised that STRANGLE would not compel the Germans to withdraw before DIADEM was launched, it was decided to continue the air campaign during the offensive. Fighter-bombers had mainly been employed in attacking road transport, and for this new stage the interdiction belt was placed closer to the German front lines where, it was thought, they could engage such transport more effectively. The object remained supply denial, with the intention of creating shortages among German front-line units while they were under pressure from Allied ground action. This too failed in its object, mainly because the previous STRANGLE effort had been conducted at a time when the German forces were not heavily engaged - they had therefore been able to accumulate sufficient stocks of

ammunition and fuel in the forward area so that shortages never became critical.

STRANGLE proved the necessity of closely integrating any interdiction attempt with ground operations, but interdiction proved a very demanding goal to achieve. For STRANGLE Allied planners estimated that the level of supplies needed by the German armies in Italy amounted to no more than some 7% of the uninterdicted throughput capacity of the railways, thus setting themselves the target of reducing more than 93% of this capability. In fact they had overestimated German supply requirements, and it has been reckoned since that successful interdiction would have required the rail system to be reduced to no more than 1 or 2% of its uninterdicted throughput.32

It is questionable whether the fighter-bombers of 1943-45 were capable of consistently destroying enough transport vehicles, railway locomotives and rolling stock, or of effecting enough road and rail cuts, to make the Germans feel the bite of interdiction in the tactical area.33 The limitations of fighter-bomber weapons and accuracy have been discussed in Chapter III. With regard to attacks on road transport, the data from the ORS investigations in Normandy (discussed in Chapter V), confirms that fighter-bomber weapons were lethal to softskin vehicles. However, maintaining a continual armed

reconnaissance meant that there were long periods when targets were relatively few, when the battlefront was static, and other less frequent periods when targets were prolific. It is interesting to compare claims made by pilots flying armed reconnaissance during these varying periods. Table XII shows the armed reconnaissance sorties and claims for MET (Mechanised Enemy Transport) made by fighter-bombers of 2nd TAF's 83 Group in what may be described as a typical fortnight during the fighting in Normandy:

TABLE XII. ARMED RECONNAISSANCE AND MET CLAIMS BY No.83 GROUP

DATE	CLOSE SUPPORT SORTIES	ARMED RECCE SORTIES	CLAIMS DURING ARMED RECCE SORTIES	
			MET DESTROYED	MET DAMAGED
30/6/44	18	152	19	41
1/7/42	28	81	3	17
2/7/44	72	113	30	16
3/7/44	117	133	25	25
4/7/44	111	138	6	12
5/7/44	107	224	22	25
6/7/44	55	218	35	50
7/7/44	72	256	18	16
8/7/44	223	320	25	69
9/7/44	120	206	none recorded	
10/7/44	67	162	11	16
11/7/44	132	148	1	6
12/7/44	72	336	44	33
13/7/44	144	118	none recorded	
14/7/44	40	136	6	12
15/7/44	88	110	11	8
16/7/44	53	63	10	20
TOTALS:	1,614	2,819	266	366

The number of close support sorties flown in the same period has been included for comparison. The table shows

that 2,819 armed reconnaissance sorties resulted in 632 motor vehicles claimed destroyed or damaged, which averages out as some four sorties per vehicle claim.34 With regard to air effort this appears as an expensive trade off.

Fighter-bomber pilots of 1943-45 ultimately depended upon the visual sighting of targets - there could be no guarantee of finding them and many armed reconnaissance patrols in such a period would have seen little or no German movement at all. Only when the German army was on the move, either during an offensive (the mounting of which interdiction was intended to make impossible) or during a retreat, could the fighter-bomber pilots expect to find targets on a large scale. This is shown in Table XIII, detailing the sorties and claims made by 2nd TAF fighter-bombers flying armed reconnaissance in a four day period during the German offensive through the Ardennes in December 1944. In this example the figures show a ratio of only one sortie per vehicle claim.35

TABLE XIII. SORTIES & CLAIMS BY 2nd TAF FIGHTER-BOMBERS, 23rd - 26th DECEMBER 1944

DATE	ARMED RECCE SORTIES	MET CLAIMED DESTROYED	MET CLAIMED DAMAGED
23/11/44	39	13	27
24/12/44	86	14	15
25/12/44	176	40	117
26/12/44	185	65	121
TOTALS	486	132	280

Table XIV reveals the same trend in slightly more detail. By focusing on particularly intensive periods of armed reconnaissance by No.609 Squadron, the table shows the difference the German retreat from the Falaise area in August 1944 had on the ability of the Typhoon pilots to find targets:

TABLE XIV. No.609 SQUADRON ARMED RECONNAISSANCE CLAIMS, JUNE - SEPTEMBER 1944.(36)

	NUMBER OF:		CLAIMS			
	Missions	Sorties	Tanks/AFVs Destroyed	Tanks/AFVs Damaged	MET Destroyed	MET Damaged
June 1944	8	64	6	11	16	8
July 1944	8	62	-	-	1	5
Aug. 1944	28	201	16	3	34	57
Sep. 1944	16	132	-	-	7	8
TOTALS:	60	459	22	14	58	78

The above tables indicate that, with regard to road movement, effective interdiction, if it demanded the prevention of all or very nearly all supplies reaching the battlefront, would have been very difficult to impose.

Tactical Mobility.

Given that interdiction efforts such as STRANGLE were not sufficient in themselves to compel a German withdrawal, then the value of a continual armed

reconnaissance during periods when the battlefront was relatively static, with no large-scale German movement, becomes questionable. Table XII, which shows that in that fortnight during the Normandy campaign there was only one day on which close support support sorties exceeded those of armed reconnaissance, begs the question of to what extent the constant patrolling of the German rear areas offered an effective means of assisting Allied troops.

The answer is that armed reconnaissance did not need to consistently destroy large numbers of German vehicles in the tactical area in order to reduce the ability of the German armies to fight effectively. As with close air support, neutralization was often more important than destruction. Armed reconnaissance rendered all German movement in and around the battle area potentially vulnerable to air attack. In his 1972 study of STRANGLE, F.M. Sallagar suggested that while the air offensive failed in its interdiction objectives, it nevertheless achieved the *'..reduction and occasional paralysis'* of German freedom of movement in the combat area, with field commanders unable to move units to strengthen threatened sectors or to seal off Allied breakthroughs without penalty.37

There is much evidence to support this view. Both in Italy and in North-West Europe German movement in and beyond the tactical area was severely disrupted by air

attack or the threat of it. In May 1944 the headquarters of Field Marshall Kesselring, commanding German forces in Italy, reported that,

> *It is impossible, in the face of such air superiority, for command to make any computation of the time element in movements.* 38

Later, General von Vietinghoff, who succeeded Kesselring in March 1945, stated of Allied fighter-bombers that they

> *..hindered essential movement, tanks could not move, their very presence over the battlefield paralysed movement.* 39

German forces in North-West Europe experienced similar difficulties, from the very outset of the fighting in Normandy. On June 10th 1944 Field Marshal Rommel, commanding Army Group B, while driving towards the battlefront, had to jump out of his car and dive for cover no less than 30 times.40 It is not surprising that on the same day he echoed those German commanders in Italy by complaining that the Allies had,

> *..total command of the air over the battle area up to a point some 60 miles behind the front. During the day, practically our entire traffic - on roads, tracks and in open country - is pinned down by powerful fighter-bomber and bomber formations, with the result that the movement of our troops on the battlefield is almost completely paralysed.*41

The extent to which the threat of air attack affected German freedom of movement is seen in a PoW interrogation report that was being studied by 2nd TAF planners in May 1944 based on information from Poles and Alsatians captured while serving in German units.

This revealed that, when air attack was likely, German motorized units moved only at night whenever possible, with movement taking place by companies at half-hour intervals and with distances between individual vehicles - sometimes as much as 50 metres - rigidly maintained. Units marching on foot in daylight posted air sentries to front and rear, and marched with an average distance of 500 metres between companies, and sometimes with a distance of 20 metres between each man. Halts, such as for meals, were made dispersed under cover whenever possible.42

Failure to observe these elaborate precautions invited disaster, but in the initial stages of the campaigns in Italy and North-West Europe German troops were unprepared for an enemy air force that would seek to attack them as they moved towards the battlefront. For example, the history of the 29th Panzer Grenadier Division records of its deployment against the Allied landings at Salerno in September 1943 that,

> *Even though we already knew from Sicily what Allied air supremacy meant, the strafing we underwent at this time...put all our previous experience in the shade. It was an achievement if one small vehicle made one short journey, darting from cover to cover, and completed it unscathed.*43

In Normandy, a staff officer of 17th SS Panzer Grenadier Division described how his division learnt

the same lesson soon after the Allied landings:

> *Our motorized columns were coiling along the road towards the invasion beaches. Then something happened that left us in a daze. Spurts of fire flicked along the column and splashes of dust staccatoed the road. Everyone was piling out of the vehicles and scuttling for the neighbouring fields. Several vehicles were already in flames. The attack ceased as suddenly as it had crashed upon us fifteen minutes before. The men started to drift back to the column again, pale and shaky...This had been our first experience of the Jabos* [fighter-bombers]. *The march column was now completely disrupted and every man was on his own to pull out of this blazing column as best he could.*44

German formations soon learnt not to present such targets to the air, but inexperienced formations arriving in Normandy later in the campaign occasionally fell victim to such attacks. On July 9th 1944 a regiment of parachute infantry was moving forward to reinforce Bayerlein's Panzer Lehr Division. Their march discipline was poor and, when near Les Champs de Losque, they were pounced upon by ten fighter-bombers which bombed and strafed them for five minutes - leaving over 200 killed and wounded out of 1,500 men. According to Bayerlein the survivors had been so shaken by this experience that he could never afterwards regard the unit as reliable. 45

Only severe weather brought respite from air attack in daylight, and the Germans were compelled to move mainly at night. A post-war US study suggests that the

ability to move unmolested at night largely redressed the balance:

> *There was one deficiency in tactical air action that was evident throughout the campaign in Europe. That was the dearth of night fighter and night intruder operations. When weather permitted, the two night fighter squadrons turned in a good performance, but there was never enough. From the early days in NORMANDY when reports from PWs, French civilians and our patrols showed that the enemy formed his columns at last light preparatory to moving throughout the night, through the ARDENNES Counter Offensive phase, during the early stages of the REMAGEN Bridgehead over the RHINE, and to the end, it was apparent that a lack of night air activity allowed the enemy the freedom of movement which he had lost by day and permitted him to redispose and resupply his forces with little danger of interference.* 46

While it is true that the Allies had few night-fighter aircraft available in North-West Europe, it is questionable whether an increase in their numbers would have had any appreciable effect on German movement. Radar with the ability to detect road and rail movement did not then exist, and attempts to operate by the light of flares dropped by accompanying bomber aircraft had only limited success. 47 In terms of interdiction, night movement ensured that at least a certain level of supplies reached the battlefront. 48 Yet, in operational terms, night movement was a very poor substitute for total mobility, particularly in summer with few hours of darkness. For example, Bayerlein recalled that in Normandy it took 36 hours to get his Panzer Lehr Division to the battlefront, a

journey which would have required no more than 12 hours had daylight movement been possible.49

Granted that armed reconnaissance patrols severely disrupted German tactical movement, one might still argue that this was not of great importance if the German formations, albeit with difficulty and perhaps losses, could still reach their destinations in time to achieve their purpose, for example to reinforce a portion of the battlefront. It is certainly true that there were occasions when the Germans had time on their side, that formations arriving at their destinations after long and difficult journeys nevertheless had time to reorganise without being under great pressure from Allied ground action. But there were also occasions when time was absolutely crucial to the Germans, such as when an offensive was to be mounted or an Allied breakthrough sealed off, and when daylight movement had to be hazarded. Then armed reconnaissance could not only take a fearful toll of the German formations but also ensure that they arrived in no state to fight effectively.

Such was the experience of the Hermann Göring Division in Italy, which was employed against the Anzio beachhead at the end of May 1944, but whose journey to the battlefront from the Leghorn area between May 23rd-27th was disrupted by air attack. Its

commander, General von Greffenberg, reported that his division had been subject to,

> *..practically unceasing low level attacks..the losses were considerable. The Division reached the intended concentration area..with only eleven tanks.*50

More tanks arrived piecemeal, but of the division's original 60 only 18 reached the battlefront. Given the limited accuracy of Allied air-to-ground weapons (see Chapter V), it is likely that few of these tanks were lost as a result of direct rocket or bomb hits, but rather due to the wear and tear of making long detours on poor roads on their tracks, the difficulties of repairing damaged tanks on the march, and shortages of spare parts and fuel due to their supporting softskin vehicles being continually shot up from the air. This also explains the fact that, of the 18 tanks that did get to Anzio, only about 8 or 10 of them were fit for action at any one time and they had little effect on the outcome of the battle. 51

Similarly, in Normandy, on the night of August 1st 1944, the 9th SS Panzer Division began to move across the River Orne from the Caen sector in order to counter the thrust of British VIII Corps towards Flers. Daylight movement was imperative, and on the afternoon of the 2nd the main body of the division was found by 83 Group fighter-bombers along the roads between Thury-Harcourt and Condé. They flew 271

sorties in the area and claimed the destruction of 10 tanks and 50 MET and the damaging of 13 tanks and 76 MET.52 Even allowing for overclaiming, the losses inflicted on 9th SS were considerable. Moreover, the division could not go into action as a cohesive body but as a series of small battlegroups; by August 4th it was fighting on the defensive. 53

Also in early August, in preparation for the German counter attack at Mortain (see Chapter V), the 1st SS Panzer Division began to move on August 3rd from the Caen area to opposite the US forces near Avranches. This also demanded daylight movement and Allied fighter-bombers turned the march into a nightmare, harrying the division relentlessly to the extent that one source states that losses amounted to 30% of strength.54 Long delay was also caused, especially when a fighter-bomber, shot down by the Division's flak, crashed onto the lead tank as the column was moving along a narrow defile, blocking the road. It took several hours for the tanks to extricate themselves and find an alternative route, and only scattered elements arrived in time to start the offensive on August 7th - armed reconnaissance thus having been responsible for a significant reduction in the tank strength available for the offensive's initial thrust.55

Extensive armed reconnaissance patrols throughout the course of the offensive also resulted in heavy losses among the transport vehicles feeding the tanks, and very little fuel reached the armoured spearheads. On August 11th an ULTRA intercept of a message from 47th Panzer Corps headquarters, directing the operation, revealed that the Germans were critically short of fuel. On the following day a further intercepted message reported that 30 tanks of Panzer Lehr were immobilised for lack of it.56 Similarly, during the Ardennes offensive, losses to motor transport as a result of fighter-bomber attack were decisive in denying both supply and mobility to the German armoured spearheads. One consequence of this was described by Bayerlein, who recalled that he had to abandon 53 tanks of his Panzer Lehr Division by the roadside during the withdrawal from the Ardennes salient in January 1945, mainly because of losses to the lorries bringing forward his fuel and spare parts.57

Such were the penalties of attempting to fight a mobile war in the face of an enemy's air superiority. The roads beyond the German forward positions were usually devoid of movement in daylight. This was continual neutralization. While armed reconnaissance sorties did not always find targets, and could not

totally prevent German supply and reinforcement, they perpetuated the threat of air attack. There is no means of computing how much German movement did not take place, or how many operations were not attempted, as a result.

CONCLUSION.

While the evidence presented in this chapter confirms that ground attack was costly, it also shows quite conclusively that the heaviest aircraft and pilot losses were not sustained on close air support missions but on armed reconnaissance or as a result of attacks upon specific targets beyond the battlefront. This should not be surprising, for the targets vulnerable to armed reconnaissance, such as supply dumps, airfields, arteries of communication leading to and from the battlefront, and concentrations of troops and armour in reserve, were vital and could be expected to have priority in flak defences. In contrast, many close support strikes were against relatively small front line targets. Even allowing for the massive German investment in automatic flak by 1943-45 it was still impossible for every pillbox, small gun position, or slit trench to be so protected.

In effect, the most dangerous flak concentrations were not at the battlefront, but behind it.

This is not to suggest that German troops in the forward area were totally denuded of flak cover, but an important factor - perhaps not given sufficient attention in previous discussion of this subject - is that when aircraft were engaging targets at the line of contact friendly artillery could play a vital role in neutralizing any known flak positions that were in range. Allied gunners were adept in the art of counter-battery fire, and by 1943-45 could bring targets under fire very rapidly (see Chapter VII above); those German flak positions that gave away their position by engaging aircraft could expect swift concentrations of airburst shelling.

The fact that Allied fighter-bombers flew considerably more armed reconnaissance sorties than close air support missions begs the question as to how the relative priorities were accorded. There was not a pronounced allocations tension between the two mission types in either Italy or North-West Europe, mainly because the Allied tactical air forces in 1943-45 had at their disposal large numbers of fighter-bombers and pilots, and a steady flow of replacements for both. This enabled a sizeable allocation of air effort to armed reconnaissance and close support at any one

time. For example, on June 11th 1944 RAF Desert Air Force (DAF) in Italy reported that,

> *The policy for the employment of our fighters and Fighter-bombers remains the same...i/e, attacks on road movement, certain rail and road bridges and having A/C available for close support..*[58]

The extent of armed reconnaissance varied according to the situation at the battlefront but was greatest during those periods when there was relatively little intensive ground fighting. Operations such as STRANGLE were mounted while Allied troops were preparing for a major offensive, but whenever circumstances forced a lull in the ground battle armed reconnaissance was reasserted. One example occurred in Italy during January 1945, when Desert Air Force reported,

> *The most noticeable feature of our activities has been the switching of the major part of our effort from the direct support of the Eighth Army in the battle area, to the interdiction of the enemy's communications...With the present stalemate on the battle front, brought about by atrocious ground conditions, it became obvious our forces could be better employed elsewhere.*[59]

The level of armed reconnaissance also rose when, after an Allied ground offensive, a breakthrough had been achieved and German forces were compelled to withdraw - as in Normandy during August 1944. This enabled the fighter-bombers to take advantage of the increased number of targets, there being in any case by then a reduction in the number of close support requests.

This is not to suggest that when conducting armed reconnaissance the tactical air forces were waging a totally separate campaign, unrelated to the requirements of the Allied armies. In fact armed reconnaissance was acknowledged by the soldiers to be an extremely valuable form of air support, and many such missions were carried out at their request. For example, on June 14th 1944, during a period when the battlefront in Italy was static, the Advanced Headquarters of Desert Air Force noted that,

> *..there is no change in the Army's requests for armed recces behind the battle area, there being very few calls for support by forward troops.*60

Ground offensives saw a considerable rise in the number of close support sorties to meet army demands, a situation that often lasted for periods of several days. Yet, despite the amount of close support required on any given day, the armed reconnaissance offensive, albeit on a reduced scale, was never compromised to the extent that the threat of air attack in the German rear areas became less viable. This was true of tactical air operations in both Italy and North-West Europe, but the daily Operations Record Book of RAF Desert Air Force in Italy provides some interesting examples from the period of the assault on the formidable German GOTHIC LINE during August-

September 1944. On August 26th Desert Air Force reported,

> *A maximum effort was put up today and a total of 664 sorties were flown in support of the Fifth and Eighth Armies. By far the largest effort was against targets in and around the GOTHIC defences..*

but the DAF report also added that,

> *Continuous armed recces were flown throughout the day covering the enemy's lines of communication but little movement was observed.*

Similarly, on September 1st 1944, Desert Air Force reported a further heavy commitment to close support:

> *A maximum effort was achieved today, a total of 690 sorties being flown. By far the greater number were in close support of the 8th Army who were attacking and advancing through the GOTHIC Line defences in the PESARO area.*

Nevertheless, the daily report adds that,

> *Apart from the close support work, armed recces of roads and rails behind the battle area were flown throughout the day to deny the enemy much-needed reinforcements.*

The same situation prevailed on the following day, September 2nd:

> *Almost our entire effort was once again concentrated upon the enemy immediately in front of the 8th Army who are advancing through the GOTHIC Line. Fighter bombers attacked gun positions, strong points, troop and tank concentrations, and flew constant armed recces over roads and rails in the enemy's rear.*[61]

That a significant scale of armed reconnaissance could be conducted at a time when army demands for a heavy scale of close support were also being met was due primarily to the air resources at the disposal of the tactical air forces. There was also, to some

extent, a merging of roles. Much of the close support for such offensive operations was provided on CABRANK, and aircraft detailed for this task, if no close support target was given, often had armed reconnaissance of a specified area as a prearranged alternative mission. Moreover, VCPs or FCPs controlling the CABRANK aircraft, if there were no targets at the battlefront requiring immediate attention, would frequently request an armed reconnaissance of the area immediately behind it. In this way many armed reconnaissance missions were directed from the battlefront.

It would be incorrect to suggest that, whatever the situation at the battlefront, close support requests were in general denied in order to maintain the armed reconnaissance offensive, despite the overall higher number of sorties for the latter. Very often the opposite was true, as shown by the procedure in use by the Allies in 1944-45 of diverting aircraft proceeding on armed reconnaissance to respond to unforseen requests for close support. The frequency of this procedure is confirmed by the fact that among many US army formations it became the preferred method of obtaining close support precisely when and where needed as opposed to relying on prearranged missions (see Chapter II above). Close air support and armed reconnaissance were in effect complementary aspects of

the same highly flexible tactical air offensive. This was most evident during mobile operations, when RAF fighter-bombers on CABRANK, and their American counterparts flying Armored Column Cover, often provided a combination of close air support and armed reconnaissance by patrolling considerable distances ahead of the armoured spearheads when close-in targets were lacking.62

While the strength of the Allied tactical air forces averted a serious allocations tension between close support and armed reconnaissance, the potential for such a tension existed. There were occasions, albeit relatively few, in both campaigns when it was necessary for the tactical air forces to simultaneously provide a major close support effort and also prevent large-scale German movement to the battle area. This was especially true when Allied troops were fighting on the defensive. Such was the case in Italy during the defence of the Salerno and Anzio beachheads against German counterattack in September 1943 and March 1944 respectively, and in North-West Europe during the German counterattack at Mortain and the Ardennes offensive. These operations demanded maximum efforts by the Allied tactical air forces which, despite their resources, were stretched in order to meet both demands.

Such emergencies were often of short duration, demanding only a few hours or a day of intensive effort which could be provided by working pilots and ground crews to the limit to achieve the necessary sorties - an example being the crisis on the first day of the Mortain counterattack, which was met by an afternoon of concentrated effort by No.83 Group of 2nd TAF and the US IX TAC. Such operations, necessitating a reduction of air effort in other sectors of the battlefront, could not be sustained for more than very limited periods, and the tactical air forces could not cope with crises of longer duration without reinforcement. For example, the extent of Allied tactical air operations, both at and beyond the battlefront, during the German Ardennes offensive was made possible only by the involvement of 2nd TAF, the reshuffling of US fighter-bomber units in order to reinforce those TACs supporting the US armies directly engaged, and the temporary posting to the Continent of two Groups of the Eighth Air Force's Mustang fighters to reinforce the IX and XXIX TACs of Ninth Air Force.63

The ability of the tactical air forces to draw upon resources of air-superiority fighters was an important factor in maintaining fighter-bomber strength. This was shown in August 1944, when the Allied landings in Southern France (Operation DRAGOON) resulted in the

armies in Italy losing the support of the US XII TAC, while RAF Desert Air Force became responsible for the whole of the Italian front shortly before the launching of a major offensive against the GOTHIC LINE. Desert Air Force was reinforced, but the almost total lack of German air opposition meant that the loss of XII TAC was also offset by several fighter squadrons having been converted to fighter-bombing - among them four squadrons of Spitfires of No.244 Wing which had been gaining experience in the role since the end of June.64

The Allied tactical air forces were also able to concentrate fighter-bomber strength in sectors of the battlefront demanding intensive effort, by temporarily assigning units to the area from quieter sectors. For example, in early 1945 Desert Air Force was anticipating demands for a heavy scale of close air support from Eighth Army, which was preparing to take the offensive. All fighter-bomber squadrons were expected to be fully occupied and, for Desert Air Force to maintain its operations, it was thought that reinforcement would be necessary. A Desert Air Force study noted that,

> *This can be provided for by temporary transfer of fighter-bomber aircraft from 22nd T.A.C., provided that 5th Army is not on the offensive at the same time.*

It was even suggested that such a step might provide a surfeit of resources, for the same study added that,

> *If it so happens that 5th Army do not undertake major offensives at the same time, then the total of D.A.F. plus 22nd T.A.C. is almost certainly too great.*[65]

In 1943-45 the Allied armies enjoyed a lavish scale of air support both at and beyond the battlefront. An indication of how their operations would have been curtailed had they been denied the support of powerful tactical air forces is shown by an incident which occurred in Italy. In December 1943 four US fighter groups of Northwest African Tactical Air Force (NATAF) were about to exchange their P-40s for P-47 Thunderbolts. Headquarters Mediterranean Allied Air Forces (MAAF) decided that, after conversion, they would be transferred to the 15th (Strategic) Air Force for fighter escort duty. Air Marshal Coningham, then commanding NATAF, warned of the consequences of such a step:

> *Experience in the Mediterranean theatre has proved conclusively that the fighter bomber, owing to its versatility, hitting power, and powers of self-defence, is the most important single factor which consistently contributes to success on land..*
> *...without fighter bombers it would be impossible to provide the necessary support for an advance..*
> *The fighter bomber force in T.A.F. has long experience and is highly specialised. The present standard is due to continuity and the inculcation of a fighter-bomber mentality born of more than two years offensive trial and error with armies. It is a difficult task which has to "grow" on a unit...*
> *...to take these units away from their specialised offensive role and convert them into a defensive escort to long range bombers is unthinkable.*

Coningham also warned that the Allied armies would become more vulnerable to a strong German counterattack directed upon either Foggia or Naples. This was because,

> *The preventive factor is the air war on enemy supply and communications, and the killing element in every enemy attack is the fighter bomber. This is especially the case in Italy where the weight of the attack depends upon roads.*66

The strength of Coningham's argument was that, if MAAF held to its decision, the result would have been to reduce the overall fighter strength of NATAF by 60%, thereby reducing the number of fighter-bombers supporting Eighth and Fifth Armies by 66% and 50% respectively. Largely due to Coningham's intervention, the decision was not implemented. Had it been, a serious allocations tension between armed reconnaissance and close air support would have been inevitable, with NATAF unable to maintain sufficient armed reconnaissance patrols to disrupt German tactical mobility, while lacking the resources to provide more than a limited close support effort.

With regard to the effectiveness of the two mission types, it can be seen that in each case the effects - neutralization and delay - were temporary. The inevitability of adverse flying weather on some days and the inability to operate at night ensured that armed reconnaissance could never completely sever the German forward troops from reinforcement and supply.

Its effect on German tactical mobility, however, was undeniably very great and sometimes decisive; it was for this reason that in 1945 ORS 2nd TAF concluded that armed reconnaissance was:

> *..the most important of all tactical air force work, because of the restrictions it imposes on enemy movement.*67

Yet in order to have this effect armed reconnaissance had to be continuous, not just to engage targets but to make credible the continual threat of air attack which paralysed the German army.

This was an advantage over close air support, for an armed reconnaissance mission contributed to this psychological effect even if the pilots found no targets - it could thus be argued that such a mission was not wasted, and that even for the aircraft to be seen over the German rear areas had some effect. This was not true of close air support to the same extent. While the presence of Allied fighter-bombers over the battle area undoubtedly curtailed German fighting efficiency by preventing movement and inducing artillery and mortar crews to desist from firing, this was of limited assistance to Allied ground units about to attack German troops already occupying fighting positions. In this situation, as the above chapters indicate, each close support strike that failed to destroy or neutralize such positions, or which, having done so, was not exploited on the ground, was wasted.

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18. Pierre Clostermann, *The Big Show: Some Experiences of a French Fighter Pilot in the R.A.F.*, (London: Corgi, 1970), pp. 217-218.
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21. The sources for Table V are many: British and Canadian Divisional and other unit records for North-West Europe are in the PRO WO 171 and PRO WO 179 files respectively. Those for RAF squadrons are in the PRO AIR 27 files.
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23. *Morale and Types of P.W. and The Effects of Supporting Arms at Calais (Operation Undergo)*, Appendix E to No.2 ORS Report No.16, *Air and Ground Support in The Assault on Boulogne*, in *Operational Research in North-West Europe*, (1945), PRO WO 291/1331.
This observed that the flak gunners were the most youthful element in the German garrison of Calais.

24. No.2 ORS/ORS 2nd TAF Joint Report No.3, *Rocket Firing Typhoons in Close Support of Military Operations*, (1945), in *Operational Research in North-West Europe*,
Had these German guns (dual-purpose 88mm's) been engaging Allied troops and been manned by troops other than trained anti-aircraft gunners, then the Typhoon attacks may well have neutralized them. There is evidence to suggest that trained and experienced anti-aircraft gunners were immune to the fear of air attack engendered in other troops. In British experience this was seen regarding the anti-aircraft gunners of Malta and Tobruk earlier in the war. This phenomenon may have been linked not only to the discipline engendered by training and experience but also to the ability to hit back offsetting fear. In North Africa British troops were exhorted to fire back at attacking aircraft even with their small-arms, this being more for reasons of British morale than any serious hope that enemy aircraft would be hit. See *Direct Support of the Army in the Field: Miscellaneous Reports*, PRO AIR 37/760.
General Messervy, commanding 4th Indian Division in North Africa at the time of Operation CRUSADER in November 1941, insisted that his men would not dive for the nearest slit trench during dive-bombing raids but would stand their ground and engage the aircraft with their weapons. For an account of Messervy setting a personal example see Henry Maule, *Spearhead General*, (London: Corgi, 1963), pp. 141-142.
25. Statistics taken from No.83 Group RAF (2nd TAF) Daily Intelligence Summaries, August 1944 - February 1945, Appendices to No.83 Group ORB, PRO AIR 25/704, AIR 25/705, AIR 25/706 and AIR 25/707.
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27. No.609 Squadron ORB, June 1944 - May 1945, PRO AIR 27/2103.
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30. Wesley Frank Craven & James Lea Cate (Eds.), *The Army Air Forces in World War II*, Volume III, *Europe: Argument to V-E Day*, (Washington, 1984, pp.373-384.
31. F.M. Sallagar, *Operation Strangle (Italy, Spring 1944): A Case Study of Tactical Air Interdiction*, RAND Report R-851-PR, (Santa Monica: Rand, February 1972), p. vi.
32. Ibid., pp. 24-32.
33. Accuracy was not the only limitation with regard to fighter-bomber attack upon railway targets; there was also the question of weapons effectiveness. Trials held in the UK in 1944 discovered that even a direct hit on a section of track by a salvo of Typhoon rockets would only cause such damage as could be rapidly repaired within 2 hours. The trials concluded that, to keep a railway line out of operation, air attacks would have to be multiplied at various points along the line. Ministry of Home Security, Research and Experiments Department, *Comments on T.A.F. trial at Shoeburyness, February 21st, 1944*, PRO AIR 37/805.
Rockets and bombs, provided they hit the target, could be relied upon to destroy or damage carriages and freight trucks. This was apparently not true of locomotives, however. Between February and April 1945 fighter-bomber pilots of 2nd TAF attacked some 500 locomotives with rockets, claiming 176 destroyed and 185 damaged. Subsequent investigation by ORS 2nd TAF found little evidence of locomotives damaged by rockets and, of the hundreds of locomotives found and examined, only four had possible rocket damage. The ORS were inclined to believe assurances by German engineers that even a direct rocket hit would not destroy a locomotive, though it was considered that rocket damage would take about a month to repair, or twice the amount of time needed to repair damage caused by strafing. ORS 2nd TAF concluded that the claims for locomotives destroyed were overstated, and that *'..a locomotive is very difficult to destroy.'* ORS 2nd TAF Report No.31 (July 1945), *R/P Attacks on Locomotives by Aircraft of 2nd T.A.F.*, PRO AIR 37/61.
34. Daily Intelligence Summaries, No.83 Group RAF (2nd TAF), June - July 1944, PRO AIR 25/698.

35. ORS 2nd TAF Report No.19 (April 1945), *The Contribution of The Air Forces to the Stemming of the Enemy Thrust in the Ardennes, December 11th-26th 1944*, PRO AIR 37/1208.
36. No. 609 Squadron Operations Record Book, PRO AIR 27/2103. Table XIV is intended to show the frequency with which road movement targets were seen by pilots. On many such missions when no road movement was seen the pilots attacked other opportunity targets, (i.e. railway lines, stations and marshalling yards. In coastal areas, ships or barges were often attacked.
37. Sallagar, op.cit., p. vi.
38. Quoted in John Ellis, *Cassino, The Hollow Victory: the Battle for Rome January - June 1944*, (London: Andre Deutsch, 1984), p. 435.
39. Quoted in Hilary St. G. Saunders, *Royal Air Force 1939-1945*, Volume III, *The Fight is Won*, (London: HMSO, 1954), p. 232.
40. David Irving, *The Trail of The Fox: The Life of Field-Marshal Erwin Rommel*, (London: Weidenfeld and Nicolson, 1977), p. 345. Rommel's career in Normandy was terminated by 2nd TAF on July 17th 1944 when Spitfires patrolling the roads near Vimoutiers strafed his staff car. Rommel suffered a fractured skull. Ibid., pp.381-382.
41. B.H. Liddell Hart (Ed.), *The Rommel Papers*, (London: Collins, 1953), pp.476-477.
42. Interrogation Report (British Army), on 17 Polish Division and 2 Alsation Division, May 1944, PRO AIR 37/831.
43. Quoted in C.J.C. Molony, *The Mediterranean and Middle East*, Volume V, (London: HMSO, 1973), p.315.
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47. Richard P. Hallion, *Strike From The Sky: The History of Battlefield Air Attack 1911 - 1945*, (Shrewsbury: Airlife 1989), p. 204.
The night intruder operations by RAF Mosquito aircraft could never match the armed reconnaissance effort possible by day. There were never more than eight Mosquito squadrons in 2nd TAF (only six until early 1945) and they averaged only 170 sorties per month, 88% of this effort being at night. ORS 2nd TAF Report No.37 (1945), *The Effort and Accuracy of Tactical Bombers in 2 Group January 1944 - May 1945*, PRO WO 291/1362.
Night-fighter operations, though few, could delay German formations moving by night. A German soldier of the 899 Reserve Regiment taken prisoner in Normandy told his captors of an occasion when his company was moving by bicycle at night. Two night-fighters flew over, dropping flares, and his company immediately dispersed into cover. Although the aircraft departed without attacking, and did not return, the company remained in cover for 20 minutes. Prisoner of War A.D.I. (K) Report No.382/1944 (July 24th 1944), PRO AIR 37/760.
48. During his post-war interrogation, Bayerlein told how German formations were resupplied at night, though the difficulties of night movement and the short summer nights made supply uncertain. In winter, due to the longer period of darkness, supply was better. Bayerlein Interrogation, op.cit., p. 264.
49. Ibid, p. 262.
50. Quoted in John Ellis, *Cassino, The Hollow Victory*, op.cit., pp. 460, 423.
51. Ibid.

52. No.83 Group RAF, Intelligence Summary No.50, August 2nd 1944, PRO AIR 25/704, Chester Wilmot in *The Struggle For Europe*, (op.cit., p. 441), mentions this incident and and gives the figure for 83 group sorties as 923, but this was the total of all 83 Group sorties during the day including close support, fighter patrols, and conventional reconnaissance. He observes that the claims are *'..broadly substantiated by German sources..'*
53. Ibid; also Lefèvre, op.cit., p. 144.
54. James Lucas & James Barker, *The Killing Ground: The Battle of the Falaise Gap August 1944*, (London; 1978), p. 76.
55. Ibid.; Ralf Tiemann & Rudolf Lehmann, *Die Leibstandarte*, Band IV/1, (Osnabrück: Munin Verlag, 1986), p. 206, (DOAC tranlation).
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66. Air Marshal Coningham, to Headquarters Mediterranean Allied Air Forces, 29th December 1943, *Memorandum on the Effect of Withdrawing Fighter Bombers From Tactical Air Force*, PRO AIR 23/1529.
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CONCLUSION.

The thesis began by posing two fundamental questions: whether the employment of aircraft in the close support role provided sufficient advantage at the battlefront to justify the necessary expenditure of effort, and whether air support proved to be of more value when directed at targets beyond the battlefront. Before answering these questions, and in order to conclude the thesis satisfactorily, it is useful to review the evidence presented in the preceeding chapters.

I. THE THESIS IN REVIEW.

Operational Research.

Contemporary operational research (OR) material is the single most important data source consulted. In fact, had no attempt been made at the time to determine the effectiveness of weapons and what particular operations had achieved, it is hard to see how any

worthwhile historical analysis of close air support could be possible.

Contemporary army records vary considerably in the extent to which the value of air support was acknowledged. Some battalion and regimental war diaries, such as that of the Irish Guards during operation GARDEN, are quite effusive. Others, such as those of the battalions which took part in the first TIMOTHY operation in Italy, actually make little mention of the air support. The reason for this is that compilers of war diaries varied in a number of ways; in temperament, in what they considered important to record of their battalion's activities, and also in the amount of time available to them to write up. Moreover, in some operations the air support may not have been so obvious to the troops being supported as in others.

Turning to the air force records, what is the historian to judge of the effectiveness of an airstrike on reading the bald statement that all bombs or rockets fell in the target area, or that the target was well covered with strikes? What inference is to be drawn from the fact that in one afternoon in Normandy, during the German armoured counterattack at Mortain, Allied fighter-bombers claimed the destruction and damage of more German tanks than the latter actually possessed for the attack?

These questions would be impossible to answer satisfactorily were it not for operational research material. With regard to the destructive effect of weapons, their accuracy, and the identification of their morale effect the ORS investigations are beyond price. Yet OR material has its limitations. As the experience of No.2 ORS and ORS 2nd TAF shows, there were too few ORS members and too little time for a fully comprehensive and quantitative study of close air support to be made. Battlefield examinations, sometimes instigated without clear directives from higher authority, were more a process of trial and error than systematic study - not least because the ORS did not know what evidence to look for until they found it. Rather these investigations, and the more general reports, offer a series of qualitative examples by which other such operations may be measured. They provide an idea of in what way air attacks could be effective.

But, given the lack of time and resources for quantitative study, are the OR data contained in a collection of qualitative examples reliable? The answer to this question is, broadly, yes. The attribution of damage and destruction to air weapons as a result of battlefield examinations can be regarded as accurate - for example the evidence indicating whether a tank had been knocked out by an

air or ground weapon was usually conclusive. From such evidence of weapons effectiveness, added to what was known of weapons accuracy, a fair idea could be given of what these weapons were likely to achieve in terms of destruction.

Beyond this point caution has to be exercised. It would be a rash historian or analyst who suggested that, because air-to-ground weapons were found to have had a certain destructive effect on one or even a few occasions, they would have the same effect on all such similar occasions. The morale effect of weapons was even more variable. There was simply not enough OR work done on air support to enable the OR scientist then, or the historian now, to state more than that under a given set of circumstances certain weapons and methods of attack had the potential to achieve a certain result.

The risk of unreliability lies not so much in the OR material itself, but in the conclusions that the unwary may draw from it. For example, because they found few German dead during their investigations of heavy bombing operations, No.2 ORS concluded that such bombing did not cause many casualties to German troops in defensive positions. Evidence from German sources (such as from GOODWOOD and Cassino) certainly confirms that heavy bombing did not cause such casualties as to completely obliterate a defence, but it also

confirms that more were killed than were subsequently found by the ORS. Moreover, the ORS discounted the fact that when possible the Germans removed their dead to prevent their discovery by Allied troops.

The impact of OR at the time was slight, and in retrospect this is not surprising. To begin with, there was little worthwhile experience of utilising ORS, and little idea of what they should be asked to do. This was found by No.2 ORS soon after arriving in Normandy, and the section began much of its work, including that on heavy bombing, on its own initiative. The fact that they were given such a free hand suggests that they were tolerated, perhaps even indulged - until they produced an unpalatable report, such as No.14 questioning the effectiveness of heavy bombing, for which they were censured, or when their reports caused embarrassing inter-service conflict such as over fighter-bomber claims.

It is questionable whether there was much likelihood of the discoveries made by the ORS with regard to air support resulting in a change of operational methods. First, as the history of No.2 ORS observes, there was no mechanism for ensuring that OR data was read or acted upon. Second, it is by no means certain that this would have been appropriate. For example, the ORS convincingly pointed out that heavy and medium bombing of gun batteries and German 'Fortress'

positions destroyed few, if any, guns and did little damage to fortifications, and that such bombing was really only of use immediately before an assault when its morale effect could be exploited. But what was the alternative when, as at Boulogne, artillery resources were limited? It was unthinkable to leave such formidable German positions unmolested in the period while an assault was prepared, and the soldiers could never be convinced of the futility of bombing, as the enduring resentment at the lack of bomber support in some operations, such as Walcheren, shows.

This gap between theory and practice was the greatest obstacle to OR data being of practical use at the time. Experienced British and Canadian battalion commanders, their company officers and men, did not need an ORS scientist to tell them that the sooner they advanced after a Typhoon attack the more shaken and demoralised would they find the enemy - in fact it was only by talking with such men that the ORS formulated their ideas. It was another matter, however, for ORS reports pointing out the limitations of air-ground weapons, outlining their morale effects and the wastefulness of airstrikes uncoordinated with ground action, and advocating a rapid follow-up of airstrikes, to have much impact at Corps and Division level. Even if such reports reached that level and were read, it was simply not possible in all cases to

ensure that airstrikes were immediately exploited. Battles are not conducive to such stage-management or to rigid timetables, and much that was unforseen could occur to prevent an attack going in exactly on schedule. Moreover, as the ORS admitted, the morale effect of air attack was a matter of a very few minutes at most.

When circumstances allowed, airstrikes were rapidly exploited. But operational planning could not be predicated solely on the likely morale effect of weapons, and there was much Army and RAF opposition to suggestions that weapons be developed with a pronounced morale effect at the expense of destructive capability. Nor could there be any question of the army ceasing to demand air attacks on known enemy positions when air support was available simply on the grounds that they were not yet ready to attack them. In short, tried and trusted methods were unlikely to be forsaken by fighting formations on the basis of OR reports, even had they been aware of them, and much of the OR data from 1944-45 is of more practical use to the historian now than it was to the soldiers and airmen then.

The Allied Air Support Systems.

The Allied air support systems were remarkable achievements. The RAF and British Army, and later the US Army and USAAF, entered the war completely unversed in close air support, lacking worthwhile experience, equipment and doctrine. Yet by 1944 the British and Americans each had in operation a joint army/air force machinery providing for the swift handling of air support requests and the command and control of aircraft extending from airfield to battlefront. Nevertheless, while the British and Americans each created a workable air support machinery, neither attained the highest level of potential efficiency. For air support to work the armies and air forces had to be very closely coordinated, and to achieve this only at the operational level, and not always then, was not enough.

Opposition, or at least lack of commitment, to the principle of close air support on the part of the RAF and USAAF was a major contributory factor, but so too was an almost complete lack of understanding of the nature of air support on the part of the US and British Armies. While junior air and ground commanders learnt by experience, at staff level this situation prevailed until the end of the war. This meant that the extra effort necessary to make the system work to

full efficiency was never forthcoming. For example, it is remarkable that training in close support for the Allied troops and air forces preparing for OVERLORD was minimal, with very few joint exercises, and that those commanders with Mediterranean experience, such as Montgomery and Coningham, were unable or unwilling to correct the deficiency. The success of air support in North-West Europe ultimately depended upon the innovation and imagination of those air commanders at a lower level, such as Broadhurst of 83 Group and Quesada of IX TAC, who had learnt air support in the Mediterranean, and who were prepared to support the army despite censure from their superiors.

The test of battle inevitably exposed weaknesses in both the US and British systems, but many of the problems, particularly those that cost lives such as poor bombline discipline and air-ground recognition procedure, could have been minimised by adequate training. It was only too obvious in Normandy, just as it had been in Sicily and early in Italy, that air and ground forces were unfamiliar with each other. In each case examining and finding solutions to the problems with close air support that were likely to be encountered had been accorded little priority.

The air support systems depended upon an extensive communications network and the rapid accumulation, processing, and dissemination of data and of

instructions based upon it. Both the British and US systems had problems with this. At the time much of the fault was considered to be due to individuals - for example in the US system the army Ground Liaison Officers (GLOs) attached to air squadrons were criticised by some army formations for not keeping the air units sufficiently informed of the ground battle situation. Yet, while variations in individual performance could adversely affect efficiency at all levels, in 1943-45 the real problem lay in the breaks in the data flow, where a man at a desk, be he an air force or army officer at a joint control centre, an air force headquarters, or at a fighter-bomber airfield, had to sift through and act upon a continuing mass of data from the battlefront. Delays here were inevitable, as was the fact that by the time ALOs or GLOs at the airfields briefed the fighter-bomber pilots their information was to some extent out of date.

<u>The Fighter-Bomber Weapon.</u>

The fighter-bomber squadrons were the cutting edge of the Allied tactical air forces, but despite the immense effort and manpower both within the air support systems and the air forces needed to maintain these squadrons, to direct them to battlefront, and to

control them once there, they were in fact blunt instruments.

The fighter-bomber of 1943-45 was certainly flexible and versatile, able to be directed against a wide range of targets, but what it actually achieved when it reached them was a different matter altogether. This was due to the limitations of the air-to-ground weapons with which it was equipped, principally their inaccuracy. Rockets and free-fall bombs, even when delivered by experienced pilots, could not be depended upon to hit their target, be it a gun position, a tank, a building, or even a bridge. With regard to close air support, when many of the targets could be expected to be small and camouflaged, this was a significant drawback. Precision attacks, if not completely beyond the capabilities of fighter-bombers of the time, were at best very difficult to achieve, and the main value of the fighter-bomber was its ability to bring to the battlefront a considerable weight of firepower with which to saturate a target area.

Close Support for Allied Mobile & Airborne Operations.

This ability was particularly important when fighter-bombers had to act as a substitute for artillery by flying close air support for armoured thrusts and

airborne operations, this being the only means of providing fire support in such operations.

With regard to the former, close air support offered two important advantages over conventional artillery support. One was that the fighter-bombers could keep pace with the advance, and the other was that they could engage targets that were very close to the advancing tanks. Yet it is apparent that it was the morale effect of air attack, rather than the destruction caused or number of casualties inflicted, that was decisive in overcoming German resistance.

Although the Typhoon attacks in support of GARDEN undoubtedly caused some casualties among the German troops, the war diary of the Irish Guards clearly describes how it was the resulting shock and demoralization that caused the German defence to collapse. This was confirmed by the fact that the Typhoons proved equally effective in inducing German troops to surrender by making dummy attacks, after their rockets and cannon ammunition had been expended. Similarly, after CYGNET, the subsequent Royal Armoured Corps report noted how the fighter-bomber attacks on German defended buildings caused a 'temporary disorganisation' which enabled the British tanks and infantry to close in and clear them with few casualties.

The problem with such neutralization, as opposed to outright destruction of the enemy, was that it only lasted while aircraft were overhead. Once they had departed, the effect soon wore off. Both on the first day of GARDEN and throughout CYGNET the air support was continuous, but the lack of progress made on subsequent days during GARDEN when the Typhoons were unavailable revealed to what extent the Germans were prepared to fight stubbornly. With Armored Column Cover there were numerous occasions when, after fighter-bombers had neutralized German positions to enable the US armour to bypass them, the occupants of these positions had subsequently recovered to offer resistance to the following US infantry.

All this suggests that, particularly when armour was advancing in terrain favouring defence, or was confined to roads, success depended upon the provision of close air support. But to maintain a CABRANK or Armored Column Cover demanded the commitment of considerable air effort. The Allies were fortunate in that air superiority had been secured, and that large numbers of fighter-bombers were available. This notwithstanding, such commitment could not be sustained for more than limited periods.

Turning to airborne operations, there were obviously problems with regard to providing close support to troops operating beyond the established front line,

particularly that of pilots correctly identifying friend from foe on the ground and the paramount need to maintain communications. Given that close air support was the only means of augmenting the firepower of lightly armed airborne troops when beyond the protection of friendly artillery, it is remarkable that the Allied airborne forces were so poorly served until nearly the end of the war.

Both the US and British airborne troops in Normandy were denied much potential air support, not because the aircraft were unavailable but because the means of contacting them were lacking. Even as late as September 1944, the British 1st Airborne Division went to Arnhem unversed in the close air support procedure that had been in use with British troops on the Continent since D-Day, and lacking adequate means to contact tactical aircraft. The subject had been given very little thought and accorded no priority, a situation that was not corrected until early 1945.

However, while it was inexcusable that little consideration had been given to close air support of the Allied airborne forces, the case can be overstated. It would have been inappropriate for airborne troops to be utterly dependent upon such support. Had 1st Airborne Division gone to Arnhem superbly equipped and trained for the utilization of close air support, this would have been of little use

had adverse weather kept the fighter-bombers grounded. Moreover, it is hard to see how the Typhoons could have intervened in the confused fighting at Arnhem without great risk to friendly troops. When they did appear, towards the end of the battle, their attacks proved to be of limited practical use and certainly not of a decisive battle-winning nature. Once again it was a case of fighter-bombers causing neutralization instead of destruction. The presence of the Typhoons kept the German troops in cover, but little advantage of this could be taken under the prevailing circumstances and ultimately the Typhoons provided the airborne troops with only a temporary respite from German fire.

Fighter-Bombers versus German Armour.

Regarding fighter-bomber effectiveness against armour, the underlying theme remains the morale effect of air attack. The ORS ground surveys at la Baleine, Mortain, the Falaise Pocket, and in the Ardennes prove that fighter-bombers, despite the claims of their pilots, did not destroy many German tanks. This was not because their weapons lacked destructive capability, but because they could not be relied upon to hit the target. What is also apparent, however, particularly with regard to la Baleine and Mortain, is

that air attack could disrupt concentrations of armour and cause widespread panic and demoralization among tank crews.

At Mortain both American and German accounts of the battle acknowledge that the intervention of the fighter-bombers, particularly the rocket-Typhoons, was decisive. Given the evidence from the ORS ground surveys of the battle area, which seems conclusive, this could only have been as a result of the air attacks disrupting the attack and causing panic - hence the number of German tanks subsequently found abandoned. Thus the reputation of the Typhoon as an effective 'tank killer' was really based upon the quite terrifying effect of salvoes of the 3-inch rocket and the fact that, despite its lack of pinpoint accuracy, the weapon could nevertheless be placed with more accuracy than free-fall bombs, thereby enabling the Typhoons to engage German armour which was very close to the positions of Allied troops.

Turning aside from tanks specifically, there is more reason to believe that fighter-bombers wrought great destruction among German soft-skin transport. This was mainly by strafing, for cannon and machine gun fire was far more accurate than bombing or rocket fire, and had a high lethality against soft-skin and even lightly armoured vehicles. Moreover, bombs or rockets did not need to actually strike such vehicles to

destroy or seriously damage them, for they were vulnerable, as tanks were not, to the blast and shrapnel caused by a near-miss. It was by attacking such targets that fighter-bombers were really most effective against armour concentrations, for if the fighter-bombers could not easily destroy the tanks they could certainly reduce the softskin vehicles keeping them supplied with fuel and ammunition.

In short, with regard to close air support, the effectiveness of fighter-bomber attack against armour on the battlefield ultimately depended upon the disruption and morale effect. With regard to attacking armour that was not closely engaged with Allied troops, such as in the armed reconnaissance role, effectiveness depended upon disruption but also upon the destruction of those vehicles keeping the tanks supplied.

Heavy and Medium Bombers in Close Support.

The success of heavy and medium bombers in the close support role also depended upon the disruption and demoralization caused by bombing, and the extent to which this could be exploited, rather than the amount of destruction or casualties inflicted.

Against pinpoint targets, such as individual gun and battery positions, heavy and medium bombing was too

inaccurate to be relied upon to score the requisite number of direct hits, while defended positions constructed of concrete and steel often proved impervious to the heaviest calibre bombs. Bombing in support of offensive operations in open country usually found the German defenders too well dispersed for the number of casualties and losses in equipment inflicted upon them to be decisive, while bombing of urban areas proved almost wholly counter-productive and a positive hindrance to the troops it was intended to assist.

What, then, could such bombing achieve? The answer to this question can only be that bombing amounted to the saturation of German defence positions with a tremendous weight of fire that, while it did not necessarily cause great destruction or massive casualties, did cause widespread disruption, shock and demoralization and left the machinery of defence temporarily unable to function and vulnerable. If this could be exploited at once by Allied troops, then significant gains could be made at less cost.

However, this was not always sufficient to secure success. GOODWOOD, for example, failed not only because sufficient German forces survived in the bombed areas to offer resistance which slowed the British advance, but also because the German defence zone was of such depth that the initial heavy bomber

strike was insufficient to blast a way through it. The entire operation was mounted on the basis of faulty intelligence and it is questionable whether a breakthrough could ever have been achieved. In contrast the bombing that initiated COBRA, while it did not completely eliminate German resistance or obviate hard fighting by the US troops, did make a breakthrough possible because the German defence that had been initially disrupted lacked depth and could not be restored.

The decision to bomb urban areas in the path of Allied troops, especially after the experience of Cassino, is difficult to comprehend. The resulting obstruction prevented the assault troops from taking advantage of the disruption of the defence, while the German troops were presented with a series of new and well concealed positions. Some of the operations in open terrain also reveal a lack of awareness on the part of the soldiers of what bombing could be expected to achieve.

The reason was that the soldiers were anxious to make progress while saving casualties, but did not understand sufficiently the implications of heavy bombing in varying terrain. They were unwilling to heed the warnings of the senior airmen, and therefore exposed themselves, when operations failed, to the not unjustified charge that the strategic bomber forces

were being used not to secure decisive result but simply to save army casualties. With hindsight the saving of soldiers' lives does not seem so reprehensible a justification, but in fact the senior airmen had some cause to oppose any diversion of the strategic bomber offensive against Germany. In 1944-45 this offensive, for which the Allied heavy bomber forces had been created, was at long last beginning to show positive results - most notably in the targeting of Germany's synthetic oil plants and the attrition of the Luftwaffe.

It is ironic that this should have occurred only after the Allied armies had landed in France, an event which both Harris and Spaatz had intended to make unnecessary through bombing. Demands from the soldiers for heavy bomber close support thus began to occur at the worst possible time for the airmen - when their strategic offensive, which had already been disrupted by the pre D-Day bombing programme in support of OVERLORD, was beginning to show results, and when they had to meet yet another, even more urgent, demand for the bombing of German flying bomb sites.

This, coupled with the fact that the airmen were doctrinally opposed to close air support, meant that such support was provided reluctantly. Hence the bitter recrimination, such as after CHARNWOOD and especially GOODWOOD, when it appeared to the airmen to

have been wasted. Their determination that the strategic air forces should not be at the disposal of the army ensured that little was done until late in both the Italian and North-West European campaigns to educate the soldiers as to the nature of heavy bombing, or to solve the likely command and control problems which cost so many lives in the short bombings.

Yet, while a more positive attitude towards close air support on the part of the senior airmen might have seen some of the command and control difficulties avoided, and thereby some of the short bombing tragedies prevented, they were fundamentally right in their contention that the heavy bombers were unsuited to the role. In fact, it is hard to see, given the nature of bombing and in what way it could be effective, how any of the heavy bomber operations could have been more successful than they were, or how further such employment could have been justified.

The COBRA bombing was vindicated by the success of the operation, while the GOODWOOD bombing was condemned by the operation's failure. Yet the bombing for GOODWOOD was no less effective in what it actually achieved than that for COBRA, while the latter operation could hardly have succeeded had the US forces been confronted with a German defence as formidable as that which had defeated GOODWOOD. Even

operation QUEEN, for which the US Army and Eighth Air Force working together eliminated the risk of short bombing, ultimately failed due to the depth of the German defence. The employment of heavy and medium bombers in close support proved to be of value only in the initial stages of set piece attacks, and for the gaining of limited objectives. If rapidly exploited, such bombing could enable Allied troops to break into German defence localities at reduced cost, but it could not ensure a breakthrough any more than could the massive artillery bombardments of World War I to which it was analogous. In short, the answer to defence in depth could only have been more, and yet more, bombs.

Fighter-Bombers Compared with Artillery.

When comparing the effectiveness of fighter-bombers and artillery in close support, it would seem that close air support could only be justified on the grounds of the pronounced morale effect of air attack.

Artillery was on hand to provide support day and night, in all weathers. Fighter-bombers could only be called upon during daylight, and then were at the mercy of the weather, making the provision of close air support highly questionable. Moreover, the Allied artilleries by 1943-45 were adept at providing fire

support very rapidly, and had attained a responsiveness that could be matched by aircraft only by the expensive provision of standing patrols in the battle area. With regard to destructive effect and lethality, air weapons were little more effective, if at all, than artillery fire against troops with a reasonable level of protection. Against troops unfortunate enough to be caught in the open, both air attack and artillery fire could be very lethal. But in the battle area German troops were rarely caught at such a disadvantage in daylight and, being on hand and well within range, it was usually artillery that was best placed to take advantage of such occurrences.

Yet, fighter-bombers offered several advantages over artillery. One was that their attacks enabled Allied troops to approach closer to the objective than could normally be possible during an artillery bombardment. Another was that air attack could achieve the neutralization of an enemy position more quickly, with the effects being of longer duration, than could be achieved by artillery. Both these considerations were vital, for experience in European operations proved that it was not how many Germans a supporting bombardment killed or wounded that was critical, but how quickly they could be rendered incapable of fighting, through shock or panic, and how long this state was likely to last. In attacks by Allied troops

upon German positions it was time that cost lives, the time, a matter of a few vital minutes, during which the German defenders could recover from the effects of bombardment and emerge from cover to man their positions. Fighter-bombers saved time.

The TIMOTHY and WINKLE methods of co-ordinating airstrikes to support the various stages of an advance exploited these advantages on a wider scale. They provided deeper and more flexible fire support throughout the course of an attack than an artillery barrage alone, as not just the German forward defence localities to be assaulted but also those positions and gun areas immediately beyond were subject to air attack and the consequent disruption. Neutralization was therefore more extensive, and was renewed at intervals.

Were these advantages enough to justify the commitment of aircraft to the ground battle area to support armies generally well equipped with artillery? Many of the airstrikes carried out in close support against German positions negated the advantages of fighter-bomber attack because they were not co-ordinated with attacks by Allied troops. Except in situations where artillery was lacking or its ammunition was in short supply, the air support offered no appreciable advantage and was wasted. Yet, because close air support, when rapidly exploited,

could enable German positions to be overcome rapidly with fewer casualties the answer to the above question is that there were occasions when such support was not only justified but vital.

The Cost Effectiveness of Close Air Support.

Whether this contribution could be made without compromising the effectiveness of those air operations conducted beyond the battlefront leads to the wider question of cost effectiveness, and inevitably to a comparison with the role rivalling close air support in terms of commitment of air effort: armed reconnaissance.

North-West Europe and Italy in 1944/45, and particularly the former, constituted the most flak-intensive environment confronting Allied fighter-bomber pilots during the war. Losses in aircraft and pilots among squadrons engaged in ground attack were high. Yet, despite the preconceived tenet held by both the RAF and USAAF that close air support was the most costly of tactical operations (see Chapter II above), statistical evidence from North-West Europe proves that close air support was significantly less dangerous than armed reconnaissance. In effect, the data suggests that the further beyond the battlefront that fighter-bombers operated, the higher their

losses. Armed reconnaissance itself varied in the losses sustained, deep penetration missions proving more costly than those conducted closer to the battlefront.

Not only was armed reconnaissance more expensive than close support in terms of losses, it was also more expensive in terms of air effort, with significantly more fighter-bomber sorties being commited to this mission type. The question remains whether the cost of armed reconnaissance in both respects was justified by the results achieved.

With regard to both close air support and armed reconnaissance these results were temporary in nature in that it was neutralization rather than destruction that was ultimately more important. Armed reconnaissance was a continual daylight air offensive over the German rear areas but, as interdiction operations such as STRANGLE proved, it was unrealistic for fighter-bombers to be expected to prevent all German road, rail and river movement and to cut off the German forward troops from all reinforcement and supply. However, their disruptive effect on German movement, due to the ever-present threat of air attack as much as the actuality of such attack, was great. This was continual neutralization, and the air effort involved was commensurate with what was achieved. So too were the losses. Supply traffic, ammunition and

fuel dumps, airfields, troop concentration areas, and those units compelled to move by daylight were of vital importance and heavily defended by flak - it was unthinkable that they should not be brought under attack, but they could not be attacked without penalty.

Close air support losses were also commensurate with the nature of the targets. Nothing was more important than the next enemy pillbox, trench, or defended house to those Allied troops whose task it was to assault it. They were similarly important to the German troops defending them, but their priority for anti-aircraft protection was low and the vast majority of such targets were undefended by flak. Moreover, flak positions in the battle area could be suppressed by Allied artillery.

In the wider perspective armed reconnaissance targets appear undeniably more important than those of close support. Yet in the 1943-45 period there is little evidence of a serious tension in determining the allocation of air units to either role, though certain trends are apparent. When the battlefront was static and the Allied armies not engaged in large-scale offensive operations the amount of close air support requests was relatively small, allowing a considerable commitment to armed reconnaissance. Once offensive operations were under way, particularly in

the initial stages, the amount of close support increased, but never to the extent as to make armed reconnaissance impossible and thereby to lessen the threat of air attack in the German rear areas. Once a breakthrough had been achieved, or the battlefront had stabilised, the priority of armed reconnaissance was reasserted.

In fact close support and armed reconnaissance were complimentary aspects of the same tactical air offensive, which remained highly flexible. The air support systems allowed for the diversion of aircraft from armed reconnaissance missions to answer unforseen requests for close support, and in the US system this became the favoured method of responding to such demands. Similarly, during large-scale close support operations involving CABRANK or Armored Column Cover, aircraft were frequently directed to armed reconnaissance when close-in targets were lacking. In fact, even during set-piece offensive operations as opposed to rapid armoured advances, the FCP and VCP controllers with the forward troops were responsible for directing a high proportion of the armed reconnaissance missions carried out in the areas immediately behind the German front line positions.

In effect, it was quite normal for fighter-bomber pilots assigned to close air support to actually find themselves flying armed reconnaissance, and for pilots

setting out on an armed reconnaissance mission to be diverted to close air support. It would be a mistake to consider that the fighter-bomber squadrons assigned to either mission type were somehow waging separate campaigns, for they were not. A study of the major ground offensive operations reveals that, in addition to the squadrons assigned to close support, those assigned to armed reconnaissance were also indirectly supporting the operation, as well as maintaining the attack upon the German rear areas, by flying armed reconnaissance over the roads leading to the battle area.

In Italy and North-West Europe during 1943-45 which of these roles was the most vital was found to depend, in practice, not upon preconceived dogma but upon the prevailing circumstances in the battle area. It is true that the disruption of German tactical mobility and of supply and communications could only be achieved by air attack whereas, in theory at least, the soldiers should have been able to achieve their objectives without close air support. But experience proved otherwise, that there was an unforseen requirement for close air support not only in emergency situations, such as at Mortain, but also to exploit the particular advantages that supporting aircraft could bring.

II. THE EFFECTIVENESS OF CLOSE AIR SUPPORT.

The Allied experience of utilising close air support in Europe during 1943-45 leads to several significant observations in answer to the question of what advantage close air support provided at the battlefront, and thereby avoiding the equivocal conclusion warned of in the introduction to the thesis. The question of effectiveness can be examined under the following headings:

Responsiveness.

Aircraft could not normally respond rapidly to requests for close air support. With regard to close support by heavy and medium bombers, the question of responsiveness does not arise as they could only be employed according to a rigid timetable, for example at the outset of a major attack. With regard to fighter-bombers, at the very least time had to be allowed for the request to be passed from the forward troops through the air support control system to the airfield, where further time was needed for a rapid briefing of pilots. Still more time was taken by the

aircraft in taking-off, forming-up when airborne, and proceeding to the battlefront.

Under these conditions, even with a squadron whose aircraft and pilots were at readiness, the forward troops would have been extremely fortunate to see their supporting aircraft arrive within an hour of the original request. This was clearly unsatisfactory, as far as the troops were concerned, for dealing with German strongpoints and pockets of resistance that were encountered during the course of an advance. In order to save time and casualties such positions had to be dealt with rapidly, and in most circumstances artillery, providing it was available, was the more effective solution. In 1943-45 the British and US artilleries possessed fire control systems whose responsiveness could not normally be equalled by aircraft.

There were two methods whereby the Allied air support systems could respond faster than by relying upon squadrons at airfield readiness. One was to contact aircraft that were already airborne in or near the battle area, divert them from their mission and direct them to respond to the request. Normally such aircraft, providing they happened to be available, were proceeding on armed reconnaissance patrols. However, time would be needed for them to change course and proceed to the particular sector of the

battlefront, where on arrival they would report to the ground controller at the FCP or contact car. The pilots would then have to be briefed before they could attack the target. There were two drawbacks to this method. One was the obvious disruption to air force planning, in that in order to respond to the close support request the assigned mission had to be dropped. The other relates to the quality of the resulting air support. Pilots diverted in this way were unlikely to be as familiar with the sector of the battlefront, the ground situation, and the relative positions of enemy and friendly troops as those of squadrons originally assigned to close support tasks and who had been given a more detailed briefing.

The second, and most important, method of responding rapidly to close support requests was to maintain standing patrols of aircraft in the battle area. Examples of this are CABRANK and, for mobile operations, Armored Column Cover. In this case the pilots would have been well briefed for operating in the battle area and made familiar with the ground situation and the positions of enemy and friendly troops. They could also respond on a par with artillery, as they could be directed onto targets as they arose. For fighter-bombers to achieve this level of responsiveness, however, demanded such a commitment of air resources that the Allied tactical air forces

in 1943-45, despite their possession of large numbers of aircraft and pilots, could not sustain such efforts for more than limited periods.

Moreover, such operations were inefficient, and involved a certain amount of waste. Maintaining constant patrols in a single area meant that many of them were not required for close support targets. In effect, supply exceeded demand and pilots were frequently directed to attack pre-briefed alternative targets or to carry out armed reconnaissance patrols in the area immediately behind the German positions. Such patrols may have reduced German defence effectiveness by discouraging movement and inducing gun positions to remain inactive. But it can also be argued that very few worthwhile targets were to be found immediately behind the German positions during a battle, particularly at a time when German troops knew the sky to be full of Allied aircraft, and that the aircraft could have been more profitably employed, in either the close support or armed reconnaissance role, in other sectors which had been denuded of both types of air effort.

Yet there was no realistic alternative. Viable close air support demanded a rapid response to support requests, and this could only be achieved if the pilots were kept overhead waiting for targets. In 1943-45 the Allied tactical air forces were able to

attain a high degree of responsiveness in close air support only as a result of the considerable air resources at their disposal, and at the ultimate expense of cost effectiveness.

Destruction of Targets.

A problem with regard to close air support never solved in the period 1943-45 was that of destructive capability. It was extremely difficult for Allied aircraft to destroy the targets that they were called upon to engage at the battlefront.

The bomb patterns of heavy and medium bombers were intended to saturate wide target areas. Yet it was consistently found that such bombing was uneven, with some areas overhit and others relatively untouched. This simply meant that when bombing German defence localities and gun areas in the field, some positions would be destroyed and others not. In fact the number of men and amount of equipment that could survive saturation bombing appear to have been a constant surprise to both Germans and Allies alike. This was not a question of accuracy alone. Dispersion did much to negate the effectiveness of the bomb patterns, but it was also found that troops well dug-in had little to fear from near misses. The destructive effect of a high-explosive bomb extended little beyond its crater,

while fragmentation bombing, lethal to unprotected troops, was considerably less effective against those that were. Heavily fortified positions of concrete and steel, such as encountered during the operations to clear the Channel ports, were impervious to even the heaviest calibre bombs. Bombing urban areas caused much devastation, but here too sufficient German troops could be expected to survive to mount a formidable defence.

Fighter-bomber effectiveness was compromised by the fact that the bombs and rockets of 1943-45 were so inaccurate that, when directed against precision targets, they were almost certain to miss them. Yet most close support targets in the battle area were precision targets because they were small. They were also usually well camouflaged, in order to hide them from the air and from observation by Allied troops. Such targets included dug-in tanks, gun and mortar positions, strongpoints and machine-gun nests. The heavy and medium bomber crews never expected to see such targets; they were intended to saturate the areas known to contain them and usually bombed from too high an altitude to distinguish anything but the most prominent landmarks. In contrast, the fighter-bomber pilot was expected to tackle such targets individually, yet he too rarely saw them. More often than not, diving at speed with only a few seconds to

aim and release his bombs or rockets, and confronted with a battle area obscured by smoke, the pilot saw only the coloured smoke fired by friendly artillery that was intended to indicate his target. This, taken in conjunction with the inaccuracy of air-to-ground weapons, meant that very few such targets were actually hit.

But if they were not hit they would not be destroyed, as near-misses by bombs and rockets against dug-in troops and equipment, or tanks, were of little value. Only strafing appears to have had the potential to inflict significant casualties, providing a large number of fighter-bombers were strafing an area containing a high concentration of troops lacking overhead protection. In effect, close air support could never be relied upon to achieve the outright destruction of targets, and attempts to ensure even a reasonable chance of such destruction demanded an inordinate scale of air attack by all aircraft types.

Neutralization of Targets.

The most important theme underpinning the observations made throughout the thesis is morale effect. The battlefield effectiveness of close air support depended upon the fact that air attack had the potential to neutralize targets more effectively than

Allied ground weapons. This really amounts to saying that air attack was more terrifying, and that the German troops subjected to it were likely to remain in a state of shock, and incapable of fighting effectively, for longer than those subjected to ground based fire support. The evidence is persuasive.

With regard to fighter-bomber attacks, accounts from British and US troops and ORS investigations all affirm that it was this temporary morale effect of air attack, rather than any destruction and casualties caused, that was decisive. There was also the very important practical consideration that fighter-bomber strikes could permit assault troops to approach closer to their objective than possible with supporting artillery fire, enabling them to take maximum advantage of the morale effect. For mobile and airborne operations close air support was the only means of supplementing the limited firepower of Allied units, and its success was crucial. But here too air support proved highly effective in the temporary neutralization of targets, rather than in their destruction.

The situation was slightly different regarding heavy and medium bomber operations, in that more destruction and casualties were likely to be caused than by fighter-bomber strikes due to the weight and scale of attack involved. Nevertheless, this was never in

itself decisive, and the progress made by Allied troops at the outset of such operations was due primarily to the morale effect of bombing. Many German troops subjected to carpet bombing survived, but they were often found to be suffering from vibratory shock, deafness and complete disorientation. Equipment may not have been destroyed, but in the period immediately following a bomber strike many of the tanks and guns were rendered temporarily unworkable by being toppled into craters or buried under dirt and debris. The problem was that the nature of such bombing often prevented Allied troops from exploiting this effect. Crater bombs ploughed up German defence localities in the field, but they also slowed the progress of Allied troops, particularly armour. Bombing defended urban areas completely disrupted the German defences, but caused such obstruction that Allied troops could not reach their objectives. In both cases, by the time the Allied troops had negotiated the obstruction caused by bombing, those Germans that had not become casualties or prisoners had recovered.

Given that battlefield effectiveness depended for the most part on neutralization rather than destruction, was this sufficient justification for employing aircraft in the close air support role? The answer is yes, but with several qualifications. The greatest justification is success, and when fighter-

bombers enabled Allied troops to secure their objectives more rapidly and with fewer casualties than would have been possible with ground based fire support then their employment was justified. So too were attacks upon German gun and battery positions which, though they destroyed few guns, significantly reduced German fire on the Allied assault troops.

Yet the success of close air support for Allied attacks depended upon the air support being rapidly exploited on the ground, and in very many instances this was not done. When such exploitation was attempted but not achieved for reasons beyond the control of Allied troops, one may say that the air support was wasted but that its employment was nevertheless justified. However, a very large proportion of close air support strikes were directed at German front line targets, within range of friendly artillery, but were not closely integrated with ground operations. Such attacks amounted to an unjustified waste of effort.

Turning to heavy and medium bomber operations, few proved to be justified by success. The bombing of heavily protected gun batteries, such as at Walcheren, or concrete and steel fortifications, such as at Le Havre and Boulogne, when such raids were not integrated with an assault, proved to be a waste of bombs. Similarly, the bombing of urban areas, even

immediately prior to an assault, proved counter-productive. After the experience of Cassino in March 1944 further such employment of the heavy and medium bomber forces seems inexcusable.

In field operations, heavy and medium bombing enabled Allied troops to overcome German defence localities in the initial stages of a major attack. But, when Allied troops were confronted with a German defence in depth, such bombing could not be decisive by ensuring a breakthrough. It was therefore not justified by results, though as this could not be forseen at the time one might argue that the attempts were justified. Each of the joint heavy and medium close support bombing operations was intended to be decisive, and the bombing that initiated Operation COBRA finally was because it made possible the breakout from Normandy. Yet, in terms of what the bombing actually achieved it had not been markedly more successful than that for GOODWOOD a week previously. It is therefore unacceptable to condemn the employment of the bomber forces for the latter operation simply because it ultimately failed, while at the same time acknowledging the contribution of the former to Allied success.

III. AN UNWARRANTED DIVERSION OF EFFORT ?

To the question of whether air support proved to be of more value when directed against targets beyond the battlefront, the answer must be that, in general, it did.

The question is most relevant to fighter-bombers, which were certainly more likely to be able to destroy the targets found beyond the battlefront than those in the immediate battle area. German motor transport was extremely vulnerable to fighter-bomber weapons, as were fuel and ammunition dumps. Concentrated attacks upon buildings used as headquarters were likely to achieve sufficient hits to make them untenable. That such targets could be destroyed by fighter-bombers is not in itself a justification for stating that attacks on them were of more value than close support. However, such targets were in fact of vital importance to the Germans, and this is reflected in the losses in aircraft and pilots sustained by the Allied tactical air forces in attacking them. Moreover, armed reconnaissance and attacks upon specific targets beyond the front line maintained a continual threat of air attack that reduced German fighting ability, with tactical mobility and supply being impossible in daylight without severe penalty.

Attaining this dominance over the German rear areas was undoubtedly vital, but it must be observed that there were occasions when close air support was necessary - for example in an emergency situation such as Mortain. In 1943-45 the Allies were fortunate in that, having achieved air superiority, they possessed sufficient aircraft and pilots to provide both a high level of close air support and also maintain a continuous armed reconnaissance offensive. While priorities varied according to circumstances in the battle area, the Allied armies were never denied the support of one mission type at the total expense of the other. The German armies in Italy and North-West Europe were under the continual threat of air attack both at and beyond the battlefront. Had circumstances been different, however, with fewer Allied air resources and a formidable Luftwaffe to be countered, then adherence by the Allied tactical air forces to their doctrine of according first priority to attaining air superiority and second priority to attacking ground targets beyond the battle area would have been justified - as it had already been by results in North Africa. Despite the advantages that it could bring to the battlefield, close air support on the scale enjoyed by the Allied armies in 1943-45 would have been impossible, and rightly so.

Turning to heavy and medium bombers, the latter must be considered as tactical, rather than strategic, weapons. Mediums were rarely employed in close support except in conjunction with the heavy bombers. They were mainly employed to bring under attack such German communications and supply targets that were beyond fighter-bomber range, and thus represented the deep strike capability of the tactical air forces. They were also employed, with some effect, to disrupt German troop concentrations and gun areas beyond the battlefront and which demanded a heavier scale of bombing than possible by fighter-bombers. Extensive use of the medium bomber squadrons in the close air support role, when large numbers of fighter-bombers were available, would have resulted in many vital targets beyond the battlefront being neglected. Moreover, lacking the flexibility and responsiveness of fighter-bombers, and their ability to attack targets in very close proximity to friendly troops, the mediums could have brought little advantage to the close support role, for which they were unsuited.

With regard to the heavy bomber forces, there can be little doubt that the strategic role for which they were created, that of disrupting Germany's economic and industrial base, was of more vital importance than close air support. The thesis has attempted to show what heavy bombing could achieve on the battlefield,

and has concluded that ultimately it was of limited effectiveness. It can be argued that use of the heavy bombers was justified on a very few occasions, namely to assist Allied troops at the outset of a major offensive. The problem was that, particularly in Normandy, employment of the heavy bombers escalated as such operations failed in their objectives. This placed the senior airmen in a dilemma. They were prepared to sanction a limited diversion of the strategic forces to support the army if the result was to be decisive - such as to achieve the breakout from Normandy. Yet when such operations failed they were obliged to sanction further diversion.

Given that the extent of close air support by the heavy bomber forces in 1944-45 was small, it might be argued that this limited effort did not in any way compromise the effectiveness of the strategic offensive. Yet the same bomber effort accorded to operations such as GOODWOOD and COBRA might have been used to render an oil plant inoperable for several weeks, or to render a railway marshalling yard unusable for days with consequent disruption to the German transportation network. The opportunity to attack strategic targets depended upon suitable weather, and the effectiveness of the offensive depended upon regular repeat attacks. Seen in this

light the effort devoted to close air support seems far less inconsequential, and harder to justify.

Another argument might be that the strategic offensive was compromised by the Allied air forces failing to determine targeting priorites, for example whether to direct the offensive against the German oil industry or transportation targets, and that its overall effectiveness was therefore questionable. It is beyond the scope of the thesis to determine which strategic target was the most appropriate for the heavy bombers, but suffice to say that such an argument is not sufficient grounds, given their battlefield effectiveness, for stating that further close support would have been desirable or justified.

To sum up, Allied close air support in 1943-45 did undoubtedly provide certain advantages that could be exploited by Allied troops. But they were highly variable, and were to a great extent incidental and made apparent only as a result of the Allied air forces possessing large numbers of aircraft for employment in the close support role. Had this situation not prevailed, these advantages would not have been in themselves sufficient to justify a diminution of either the tactical air offensive against German movement and supply behind the battlefront, or the strategic offensive against Germany's war effort.

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No.3 *Investigation of an Attack on a German Column near La Baleine.*

No.5 *Bombing of Caen, 7th July 1944.*

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No.8 *Bombing in Operation TOTALISE.*

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